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FM 38-5

DEPARTMENT OF THE ARMY FIELD MANUAL

**LOGISTICS
MAINTENANCE
MANAGEMENT**

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FOREWORD

Field Manual 38-5, *Logistics Maintenance Management*, as of the time of publication, presents doctrine for the "producer-wholesale" area of maintenance in support of the U.S. Army in the field.

This manual is concerned with the policies, principles, organizations, and operating techniques of maintenance management and the skills necessary to implement them. Doctrine covering the details of the administrative areas and more complete consideration of the techniques of application are included in other appropriate field manuals and authoritative publications, a list of which is included in the appendix. The present era of technological advancement, and the continuing improvement in organization, management, and operation concepts will make modifications of this manual mandatory.

Users of the manual are encouraged to submit recommended changes or comments to improve the manual. Comments should be keyed to the page, paragraph, and line of the text in which the change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. Comments should be forwarded to the President, U.S. Army Maintenance Board, Fort Knox, Ky. See AR 310-3 for desired format for corrections and changes.

USAMB will prepare and process changes to the manual on an annual basis.

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LOGISTICS

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PART ONE

MAINTENANCE GENERAL

CHAPTER 1

INTRODUCTION

Section I. PURPOSE AND SCOPE

1. Purpose

This manual contains Army doctrine in the field of maintenance management. It is designed to provide a basis for appropriate courses of instruction in the Army school system, to furnish definitive guidance for operating agencies in the field and to stimulate productive approaches to maintenance management problems on the part of all military and civilian personnel who have responsibility for maintenance management throughout the Army. It is concerned with the policies, principles, organizations, and operating techniques of maintenance management and the skills necessary to implement them. The material presented here is applicable without modification to both nuclear and nonnuclear warfare.

2. Definition

The term "maintenance" as used herein includes all actions necessary to keep Army equipment in serviceable condition, including repair, overhaul, servicing, inspection, testing, modification, cannibalization, and disposal.

3. Scope

Within the encompassing term "logistics," maintenance is centralized functionally. The subject is developed in five parts:

a. Part I: Introduction to Maintenance. This part contains discussion of the concepts and policies of maintenance management, the organization for Army maintenance, the relationship of maintenance to the life cycle of items in the system, and maintenance support policies.

b. Part II: Planning, Programming, Budgeting, and Funding for Maintenance. This part deals with the financial aspects of maintenance management from planning through programming, budgeting, funding and their associated systems of control.

c. Part III: Depot Maintenance. Covered herein are the techniques of IROAN, depot organization scheduling, parts and production management and cost control of depot maintenance operations.

d. Part IV: Field and Organizational Maintenance. The missions and organization of field maintenance, maintenance support of the Army in the field, shop management, organizational maintenance and parts support for field maintenance are contained in this part.

e. Part V: Maintenance in the Future. Examined here are some of the circumstances and problems which will confront the maintenance manager with respect to rapidly changing concepts of ground warfare.

Section II. SIGNIFICANCE OF MAINTENANCE

4. Equipment Support

a. The purpose of maintenance has not changed since warfare began; it is to keep the equipment in the hands of military forces

operable and thereby maintain the forces themselves in a condition of combat effectiveness. The importance of maintenance, however, has increased enormously and will continue to in-

crease at an accelerating rate. The significant factor is the multiplication of firepower, transportation, communications, and virtually every field of military capability through the development of new equipment. With the introduction of firearms, the increment of military power offered by equipment was increased. Today when an infantry squad or platoon has firepower equivalent to that of an entire division in World War II, the equipment component of military capability has grown to a fantastic degree. In these circumstances, operability of highly complex equipment is of paramount importance. Deadlined items are useless if decisions made on the assumption of full military capability commit units to action with only a fraction of their assumed power.

b. The supreme importance of maintenance to combat effectiveness is not altered under present peacetime or limited emergency conditions. Readiness for combat demands the same preparation and effort on the part of the entire maintenance organization, with the added constraint of limited resources to do the maintenance job.

5. Maintenance in the Logistics System

Within the overall support structure of the Army, maintenance functions and resources take on increased significance. Approximately 85 percent of all items in the supply system are repair parts, outnumbering the end items which they support by a ratio of more than 20 to 1. Maintenance is considered in nearly every phase of the life cycle of an item, from initial research to disposal. Design changes are introduced for ease and lower cost of maintenance; modifications are made to cope with maintenance problems appearing in the field; and items are disposed of when they reach their limit of economical repair.

6. Environment of Maintenance

a. The strategic, tactical, and economic environment of maintenance imposes certain basic problems and limitations upon the maintenance manager. Even in the continental United States (CONUS) and in every oversea theater, maintenance activities must be geared to operate under combat conditions, with the

probability of extensive damage to facilities and supply lines as well as to the equipment which must be supported. Extreme conditions of usage and climatic environment must also be accepted and overcome by the maintenance manager in supporting the Army's global mission in peacetime no less than in war. The equipment itself is not always designed for the most efficient maintenance, and may appear in numerous makes, models, and modifications which complicate the support and repair tasks. Both of these latter factors must be given increasing attention by qualified maintenance engineers in the design and developmental phases.

b. Resources available to the maintenance manager may be limited not only by funds restrictions, but by the quantity, quality, and training of users, operators, and mechanics. Within these limitations, and subject to governing regulations and directives, the manager must operate effectively and economically to perform a vitally important function.

7. Disposition of Resources

The decision and responsibilities of maintenance management apply primarily to three types of resources: parts and supplies used for maintenance, facilities, and personnel. These three are factors in maintenance decisions at all levels, from Army-wide maintenance planning to management of preventive maintenance within a using unit. An appropriate balance of employment among parts, personnel, and facilities to obtain maximum operational capability for least expenditure of total resources is an index of effective maintenance management. Current systems of funding and cost control are capable of providing important information to the manager by translating his utilization of different types of resources into common dollar terms. Excessive use of parts will unnecessarily tax limited supply support capabilities, and inefficient use of personnel may reduce combat capabilities. Effective management analysis and decisions on the part of all personnel responsible for maintenance operations are required both for the present complexities of the maintenance job and for the acceleratory pace of future developments.

CHAPTER 2

ORGANIZATION FOR ARMY MAINTENANCE

Section I. GENERAL

8. Principles of Logistics Organization

a. The Army establishment is organized at all levels to provide for specific responsibility and accountability for each principal activity within the Army's mission. Logistics management in the Army, as in all of the military services, is recognized as a distinct function of command which must be exercised where possible by organizational elements whose primary responsibility and capability lie in logistics areas. This distinct assignment of logistics responsibilities to specific elements of Army organization in no way divorces logistics from command. The commander retains ultimate responsibility for logistics as well as for operations, personnel, and other activities. Maintenance is, in turn, a functional element within the "supply system." Like other supply functions, such as procurement, requirements, or storage and distribution, maintenance is treated as a distinct functional entity.

b. In considering the Army's logistics organization, it is necessary not only to relate logistics to command, but to recognize the interdependence and the relation of logistics functions to the commodity structure of the Army supply system. Within each parent organization of the Army establishment, provision must be made for close communication with and coordination of each logistics element. The lines of responsibility and authority pertaining to materiel management must be clear. There must be a point of time and place in each organization at which these lines come together for purposes of making decisions which consider the total logistics picture. The Army has endeavored to provide for cohesive management of material through the technical services. Organized around commodity groupings, the technical services provide, within their organizations, a

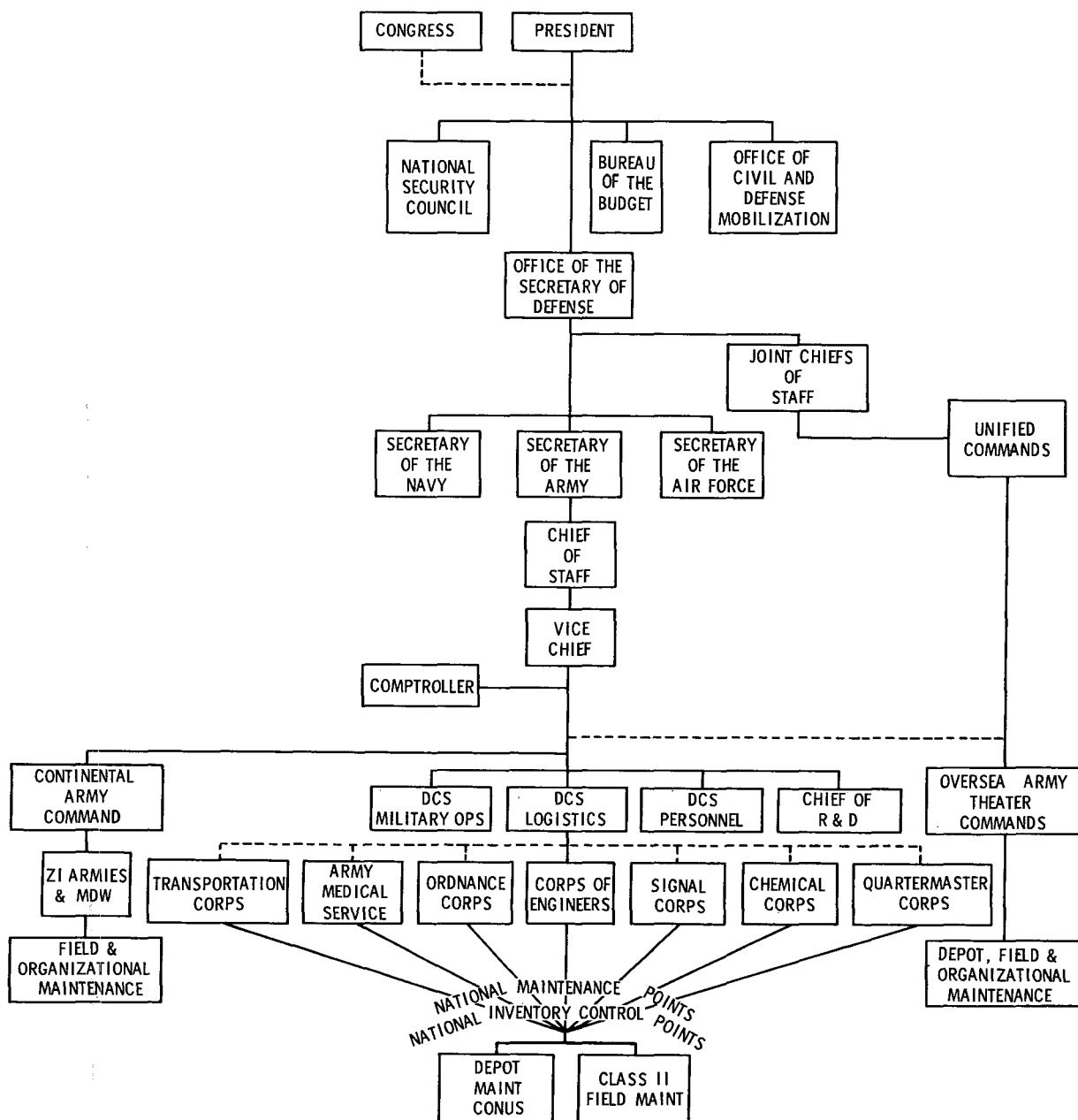
means of managing each item of equipment throughout its total life cycle, from research and development to disposal. The technical services, however, also tend to operate functionally with organizational elements responsible for each logistics function. The logistics system as a whole is a commodity organization superimposed on a functional organization.

9. Pattern of Logistics Organization

a. Figure 1 illustrates the fundamental organizational structure of the National Defense Establishment and of the Department of the Army with respect to maintenance. Figure 2 relates these organizations to their basic Army-wide maintenance responsibilities. From these charts it can be seen that maintenance management is a responsibility shared in varying degrees by many levels of the Government as a whole and by the Department of the Army in particular. The basic policies and programs which bear on maintenance are established at the highest levels of the national security organization.

b. Within the Department of the Army, logistics, like other military functions, is controlled within distinct and separate channels on either a staff or command basis. DCSLOG serves the Chief of Staff in a staff capacity, charged with exercising technical staff supervision over logistics functions throughout the Army, and directs and controls the logistics functions of the technical services. The technical services, in turn, exercise technical staff supervision over all materiel, facilities, and personnel within their respective services. They operate in a command capacity only with respect to activities and personnel specifically assigned to their control by Department of the Army. The functions and organizations and the

**GENERAL ORGANIZATION OF THE FEDERAL GOVERNMENT AND
OF THE DEPARTMENT OF THE ARMY RELATED TO MAINTENANCE**



1 July 1961

Figure 1. General organization of the Federal Government, and the Department of the Army related to maintenance.

BASIC ORGANIZATIONAL RESPONSIBILITIES FOR ARMY MAINTENANCE

ARMY MAINTENANCE RESPONSIBILITIES	RESPONSIBLE ORGANIZATION
NATIONAL SECURITY POLICIES	PRESIDENT, NSC, CONGRESS, DOD
APPROPRIATIONS	CONGRESS
BUDGETARY AND FUNDING CONTROLS	DOD, DA, BUREAU OF THE BUDGET
LOGISTICS AND MAINTENANCE POLICIES	DOD, DA, (DCSLOG)
MATERIEL DEVELOPMENT	CHIEF, R & D; DCSLOG; DCSOPS; USCONARC; TECHNICAL SERVICES
ARMY-WIDE MAINTENANCE PROGRAMS	DCSLOG
TECHNICAL SUPERVISION OVER ALL ASPECTS OF MAINTENANCE MANAGEMENT	TECHNICAL SERVICES
CONUS DEPOT MAINTENANCE PROGRAMS AND OPERATION	TECHNICAL SERVICES
OVERSEA DEPOT MAINTENANCE PROGRAMS AND OPERATION	OVERSEA COMMANDERS
FIELD MAINTENANCE	TECHNICAL SERVICES; OVERSEA COMMANDERS; USCONARC
ORGANIZATIONAL MAINTENANCE	UNIT COMMANDERS

1 July 1961

Figure 2. Basic organizational responsibilities for Army maintenance.

general responsibilities of DCSLOG and the technical services are set forth in AR 10-5.

c. Command over the Army's operating force is exercised by the Chief of Staff.

- (1) In CONUS the chain of command runs from the Chief of Staff to the Commanding General, United States Continental Army Command (USCONARC) through the commanders of the zone of interior armies and the Military District of Washington to the commanders of troop units in class I installations.

- (2) Oversea units are under field armies and Army theater commanders. The latter, in turn, report to unified theater commands (such as Commander in Chief, Pacific (CINPAC), which report operationally, to the Joint Chiefs of Staff.
- (3) There are certain Army field commands in CONUS, such as United States Army Air Defense Command (ARADCOM), and Department of Army agencies, such as the Army Security Agency (ASA), which report directly to Headquarters, Department

of the Army. For these units, the special command relationships within CONUS are outlined in AR 10-50.

10. Organization for Maintenance Operations

The actual performance of maintenance operations is a function of command, and re-

sponsibilities are assigned to various levels of command. The organization for performing maintenance operations can be understood most easily in relation to specific maintenance categories. A detailed description of the Army's structure for performing maintenance is contained in parts three and four of this manual.

Section II. MAINTENANCE MANAGEMENT AT NATIONAL POLICY LEVELS

11. Executive Office of the President

a. As the Chief Executive of the United States and Commander in Chief of the Armed Forces, the President is the focal point of the national security organization. He is responsible for executing the laws enacted by Congress and for directing the affairs of the Executive Branch of the government.

b. The President is assisted in establishing national security policies by the National Security Council and, in fiscal aspects, by the Bureau of the Budget. The National Security Council is comprised of the heads of the Executive Offices, such as the Secretaries of State and Defense and the Director of the Office of Civil and Defense Mobilization, whose policies and programs directly bear on national security. Many of the decisions made by the President have a considerable impact upon Army logistics policies. Policy decisions made with regard to such matters as force levels, weapon systems, oversea deployments, budget ceilings, and policy action commitments all ultimately affect the amount and nature of Army maintenance support required over a given period.

c. The Bureau of the Budget has a direct effect on fiscal aspects of Army maintenance. It reviews and adjusts requests for all Government appropriations to be included in the President's budget and for apportionments to be made to executive agencies after congressional appropriations are made. Included in this review is the Operation and Maintenance, Army (O&M, A) appropriation, Army Stock Fund and the Army Industrial Fund, which, collectively, form the financial base for maintenance operations.

12. The Congress

The Congress provides both the statutory framework within which the Army logistics

system must function and the appropriations necessary to its operation. Hearings held by congressional committees often deal with such maintenance issues as overhaul backlogs, industrial funding at maintenance shops, and repair parts procurement. Congressional hearings may lead to changes in appropriations requested in the President's budget or to other legislation affecting the Defense Establishment. The appropriations function of Congress is particularly important to Army maintenance. Changes in the President's budget for operation and maintenance necessitate last-minute revisions to maintenance programs.

13. Department of Defense

a. The Department of Defense includes the Office of the Secretary of Defense, the Joint Chiefs of Staff, and the military departments. The Secretary of Defense is responsible for accomplishing the military aspects of the National Security Mission, as defined by the National Security Council and delegated by the President to the Department of Defense.

b. The Joint Chiefs of Staff are the military advisers to the President, the National Security Council and the Secretary of Defense. They prepare the strategic and integrated logistics objectives and plans for the Defense Establishment. The objectives, force requirements, and plans of the Joint Chiefs of Staff are the basis for the Army's preparation of its plans for force levels, materiel, and facilities; in this way, the actions of the Joint Chiefs of Staff shape Army maintenance planning.

c. The influence of the Secretary of Defense over Army logistics policies is significant. He establishes departmental directives and regulations covering many areas of supply and maintenance management, such as cataloging and standardization and maintenance engineer-

ing policies. The Department of the Army implements Department of Defense directives

by preparing detailed regulations in support of Department of Defense policies.

Section III. MAINTENANCE MANAGEMENT AT DEPARTMENT OF THE ARMY LEVEL

14. The Secretariat and the Deputy Chief of Staff for Logistics

a. *Office of the Secretary.* Broad policies and programs which affect Army maintenance emanate from the Office of the Secretary of the Army. The Office of the Secretary includes the Secretary of the Army, the Under Secretary, and four Assistant Secretaries. The Assistant Secretary of the Army for Installations and Logistics [ASA (I&L)] is directly concerned with Army maintenance. He does not, however, exercise direct command over military logistics operations. His primary duties are to insure that Presidential and Department of Defense policies are implemented by lower echelons in consonance with Department of Army responsibilities and capabilities, and to act as the staff advisor to the Secretary of the Army on logistics matters.

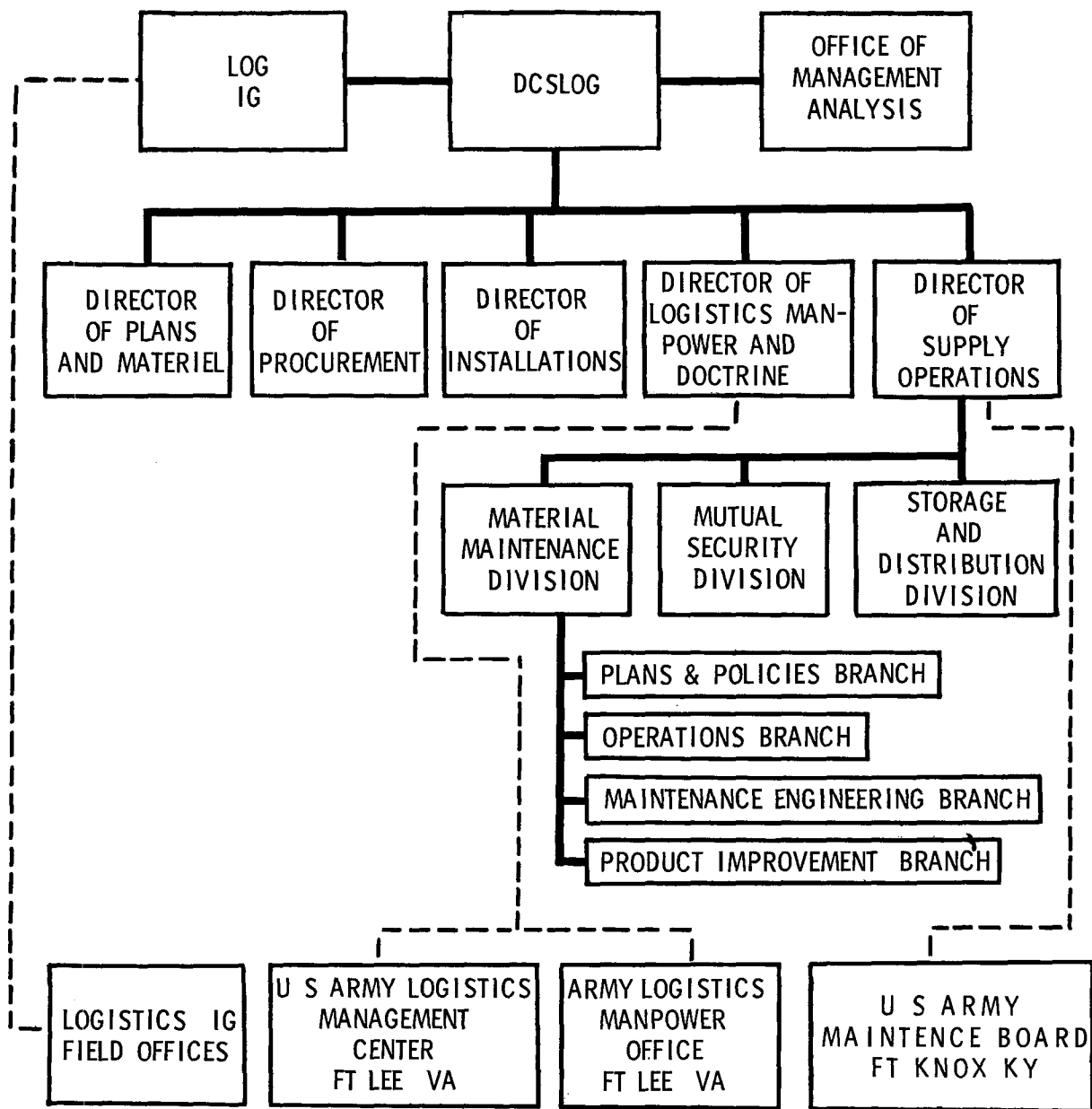
b. *The Deputy Chief of Staff for Logistics.* Specific formulation and execution of Army logistics policies are a command responsibility of the Chief of Staff, who has, in turn, delegated authority for supervising the logistic mission of the Army to the Deputy Chief of Staff for Logistics (DCSLOG). Figure 3 illustrates the organization of DCSLOG. The DCSLOG directs and controls the seven technical services and exercises staff supervision over the logistics operations of the continental and oversea commands. The DCSLOG has several special assistants, an office of management analysis and five directors reporting to him. The directors specialize in five areas: Plans and Materiel, Logistics Manpower and Doctrine, Installations, Procurement, and Supply Operations. The Director of Supply Operations has under his jurisdiction three subsidiary divisions: Storage and Distribution, Mutual Security and Materiel Maintenance, and, in addition, a DCSLOG field agency, the U.S. Army Maintenance Board.

c. *Materiel Maintenance Division.* The Materiel Maintenance Division of the DCSLOG (fig. 3) is the key policy making and super-

visory body for Army maintenance charged with the following general responsibilities.

- (1) Develops or approves all Department of Army plans, policies, and procedures governing the Army's maintenance system and supervises their implementation, exercising continuous management supervision and review over the functioning of the system to insure maximum effectiveness and economy of operation.
- (2) Supervises the development and execution of the Army's programs for maintenance; maintenance management improvement programs and maintenance expenditure control systems.
- (3) Exercises staff supervision over the operating elements, facilities and procedures of the Army maintenance system designed to provide for and effect adequate and timely maintenance of materiel for all Army operations and for other agencies, programs and departments which have been authorized Army support, to include the establishment, transfer or discontinuance of field and depot maintenance repair shops.
- (4) Develops and monitors maintainability evaluation and review programs of the technical services to insure that proper consideration is accorded these programs in the design and development of new equipment. This includes all programs having the objective of reducing—
 - (a) the requirement for repair parts;
 - (b) quantitative and qualitative technical skills;
 - (c) frequency of maintenance; and
 - (d) the time required for maintenance and improving accessibility for maintenance.
- (5) Supervises the Army's Maintenance Engineering Program to include all

ORGANIZATION OF DCSLOG FOR MAINTENANCE



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Figure 3. Organization of the Office of the Deputy Chief of Staff for Logistics.

actions necessary before the introduction of new equipment into the inventory and all actions taken after equipment is in the field that insure the effective support and operation of the Army's equipment. The "before" actions include effective and timely preparations of—

- (a) maintenance concepts;
- (b) maintenance support plans;
- (c) maintenance evaluation and allocation of maintenance responsibilities;
- (d) maintenance manuals;
- (e) repair parts appendixes;
- (f) special tools and text equipment lists; and
- (g) the initial provisioning of parts.

The "after" actions include supervising Army-wide programs relating to engineering changes, modification and retrofit and all changes necessary to keep current maintenance support plans and allied literature.

d. U.S. Army Maintenance Board. The Board's mission is to assist the materiel maintenance division in the accomplishment of its missions.

15. General Maintenance Responsibilities

The core of the Army Maintenance system lies in the seven technical services—the Chemical, Ordnance, Quartermaster, Signal, and Transportation Corps, the Army Medical Service, and the Corps of Engineers. The technical services perform their mission of providing logistic support to the Army establishment under direction and control of the DCSLOG.

a. Staff Responsibilities. Acting in a staff capacity, the technical services are responsible for providing the following basic maintenance services.

- (1) *Technical doctrine.* This includes the preparation of maintenance concepts, maintenance support plans (e.g., maintenance evaluation, maintenance allocation charts, technical manuals and repair parts appendixes, and lubrication orders) modification work orders, technical bulletins, and main-

tenance serviceability standards. It includes computation of allowances for and allocation of repair parts, tools, and test equipment. Doctrine is also developed to cover techniques of maintenance, maximum allowable repair expenditures, uniform inspection procedures, shop methods and layouts, use of maintenance support equipment, and training techniques.

- (2) *Technical supervision.* The technical services are responsible for Army-wide technical supervision of maintenance. Supervision includes insuring that all technical doctrine is implemented and that maximum allowable expenditures for repair are adhered to. It also includes the monitoring of field and depot shop inspection practices to insure more uniform application.
- (3) *Technical assistance.* Technical services provide major commands and their own activities with a broad technical assistance program. This program encompasses such services as new equipment training, determining economic reparability, explaining and interpreting maintenance doctrine, and reporting on unsatisfactory performance of materiel or recommending equipment improvement.
- (4) *Technical training.* At their respective service schools, the technical services provide training in field maintenance for personnel who will be assigned to technical service units.

b. Command Responsibilities. The technical services command certain troops, organizations, activities, and installations, assigned by the Department of the Army. These include: research and development activities; laboratories and subordinate materiel and training commands; National Inventory Control Points; National Maintenance Points; all CONUS depots and arsenals; and field maintenance activities and shops at class II installations in CONUS. The command functions pertinent to maintenance which are carried out by the technical services at activities or installations assigned to them involve—

- (1) programing, budgeting, funding and scheduling and controlling all maintenance operations at depot and field maintenance shops at class II installations; and
- (2) exercising operational control over military and civilian personnel.

16. General Organization

a. Because of scattered physical locations of functions, missions, and commodities assigned to the technical services, they have had varying approaches to maintenance management. The maintenance management activities of the seven services consequently differ in the degree to which they have been delegated to subordinate elements and the degree to which they have been integrated with inventory control points or research and development activities.

b. The most effective organization for maintenance management is the National Maintenance Point (NMP)—an organizational unit or segment within a technical service, charged by the head of the technical service with the responsibility for all practicable aspects of

maintenance management at the commodity level. The NMP organization closely parallels that of National Inventory Control Points (NICP's), which provide for integrated materiel inventory management. Generally speaking, maintenance programing and scheduling is carried out in conjunction with the NICP. The NMP is responsible for all maintenance engineering services. Army regulations on the role, duties, and responsibilities of NMP's is currently under development.

- (1) All technical services except the Army Medical Service operate NICP's on a commodity basis; they do *not* all operate NMP's. Those technical services which do operate NMP's generally have their NMP organizational elements physically located with the NICP's and closely related to their operations.
- (2) Some technical services do not operate complete NMP's; their maintenance management functions are complete for some commodities, and are fragmented into various organizational elements for others.

Section IV. MAINTENANCE ORGANIZATION AT THE U.S. CONTINENTAL ARMY COMMAND LEVEL AND WITHIN ZONE OF INTERIOR ARMIES

17. General

The primary maintenance responsibility of the United States Continental Army Command (USCONARC) and of the ZI armies is to insure the effective operation of organizational and field maintenance. As a major tactical command, USCONARC plays a vital role in setting requirements for, and assisting in, the development of new materiel. Both USCONARC and the ZI armies operate under a general staff organizational structure with supporting special staffs. The latter include representatives of the various technical services. Staff supervision of maintenance responsibilities are lodged with these technical service staff officers.

18. USCONARC Maintenance Organization

a. Headquarters, U.S. Continental Army Command, operating under a general and special staff concept includes a Combat Develop-

ment Section and a Materiel Development Section.

b. The Deputy Chief of Staff for Logistics, USCONARC, has general staff responsibility for maintenance. The Maintenance Division of the Logistics Section develops maintenance policies for USCONARC within the policies established by the Department of the Army. It insures that field and organizational maintenance procedures, training, publications, equipment and facilities meet the requisite Army standards. The Division prepares the maintenance portion of the Program and Budget Guidance for programing and scheduling field and organizational maintenance. It exercises general staff supervision over the maintenance portion of the operating budget of the ZI armies.

c. The technical service staff assists in the development of USCONARC maintenance

policies and programs related to particular items or weapons systems.

d. USCONARC Boards are part of USCONARC's test and development organization. These Boards figure prominently in the development phase of the life cycle of an item and review military characteristics and participate in engineering and user tests.

e. The chiefs of technical services DA maintain close liaison with USCONARC and its subordinate agencies on maintenance matters, particularly the development of new items of equipment, the development of maintenance policies, and effective maintenance operations.

19. Organization of a Zone of Interior Army

The ZI armies also operate under the line and staff organizational structure. Technical staff supervision over maintenance is discharged by the responsible technical service officer, who insures that adequate field and organizational maintenance is provided for the materiel within his purview. Although these organizational and field maintenance units are

in the ZI army chain of command, technical liaison is maintained with technical service headquarters, National Maintenance Points, and depots.

20. Maintenance Organization Overseas

a. The maintenance problems encountered in overseas commands tend to be more acute than in the CONUS because of the combat-ready status of the field forces and the length of the supply pipeline. The organization for maintenance overseas does not differ appreciably from that of the operating forces in the CONUS; the chief difference being that overseas depots are a command responsibility of the theater commander. The programing for overseas depot overhaul must be coordinated with technical service NICP's in CONUS.

b. The technical services provide technical guidance and assistance to overseas commanders. Field maintenance general and direct support units overseas are composed of technical service forces. They are commanded by operating commands.

CHAPTER 3

MAINTENANCE AND THE LIFE CYCLE

Section I. THE LIFE CYCLE

21. Scope

a. The effective, economical operation of the Army maintenance system is clearly essential to the support of the Army in garrison and in the field. Maintenance must be considered during every stage of the life cycle, as an item progresses from requirement and planning phases, through research and development, to its in-service period, and finally to its obsolescence phase and ultimate disposal.

b. The Department of the Army fully recognizes the necessity for early consideration during the life cycle of new equipment of optimum design for maintainability and adequate maintenance support planning during the development stage. Maintainability and maintenance support must be considered from the drawing board to the production line. Planning must begin with maintenance evaluation and maintenance engineering of prototypes at the time of engineering testing of new equipment. There are numerous problems to overcome in realizing these maintenance requirements during development. Obstacles, such as resistance from design engineers, project telescoping, and inadequate organization and procedures for maintainability review or for meaningful maintenance evaluation may be encountered, any one of which may impede the execution of Army maintenance policies.

22. Life Cycle of an Item

a. Figure 4 illustrates the life cycle of an item in the military service—often, however, the steps in the cycle will be overlapped or conducted concurrently. New items are developed in consonance with overall Army operational and logistics objectives and with the state of the technological arts. In some instances, strategic and tactical needs stimu-

late technological development; in others technological breakthroughs, such as those in atomic energy, generate radical revisions to strategic objectives. From the overall objectives stem *Qualitative* Materiel Development Objectives, which are Department of the Army-approved statements of military need for development of new materiel whose feasibility is as yet undetermined. The Deputy Chief of Staff for Military Operations has general staff responsibility for the review, coordination and approval of the Qualitative Materiel Development Objectives and incorporation, as appropriate, in the Combat Development Objectives Guide (CDOG). Based on these objectives Qualitative Materiel Requirements (QMR's) are established. These are statements of need for new items systems or assemblages, the development of which are believed to be feasible. The Chief of Research and Development has primary Department of the Army responsibility for review, coordination, approval and modification of QMR's and for their publication in CDOG.

b. Proposed QMR's for new or improved materiel for use in the field Army are prepared by the CG, USCONARC and submitted to the Department of the Army for approval. Other using agencies prepare and submit to the Department of the Army for approval, through the CG, USCONARC for review, QMR's for materiel for use by units of the Army in the field.

c. The agency preparing QMR's for submission includes a statement as to whether the information contained therein is sufficiently detailed to serve as Military Characteristics (MC). When the characteristics stated in the QMR are not in sufficient detail to permit the establishment of a development project, MC's are submitted as soon as the availability of

SPECTRUM OF THE LIFE CYCLE OF AN ITEM

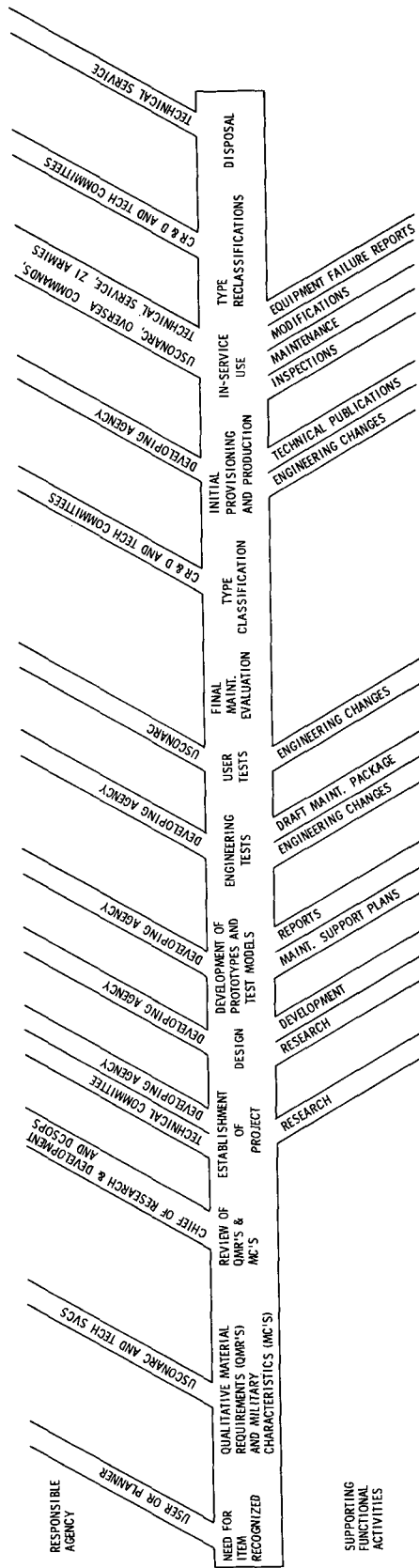


Figure 4. Spectrum of the life cycle of an item.

sufficient information permits their preparation. Military Characteristics, which are statements of those capabilities of an item, weapons system, or assemblage which will enable it to fulfill a specific QMR, are prepared and submitted for various categories of materiel by the same agencies, through the same channels as prescribed for the submission of QMR's. The Chief of Research and Development forwards approved QMR's or MC's after coordination with other staff activities (i.e., DCSLOG) to the appropriate developing agency with implementing instructions. If feasibility of the project is known, the Chief of Research and Development directs the establishment of a development project. If feasibility is not known, the Chief of Research and Development may direct the appropriate developing agency to conduct a feasibility study. The QMR's and/or MC's, together with the feasibility study, are then forwarded to the Department of the Army Staff for approval. Approved QMR's and/or MC's are recorded by the technical committee of the developing technical service. Recording by the technical committee insures coordination of the interests of all developing and using agencies including those of other governmental agencies which might be involved. After approval the developing agency prepares accompanying technical characteristics.

d. After the Military Characteristics have been reviewed and recorded by the technical committee, the "Establishment of Project" phase begins. At this stage, the appropriate technical service establishes a research and development project for the item. This is followed by the "Design of the Item" phase, in which blueprints and three-dimensional mock-ups are made. The next phase is "Development of Prototype." During this phase theoretical considerations may still crop up, and side excursions into research may be necessary. Except for minor changes, however, the item is usually close to the final product, both in its characteristics and its materials. It is, of course, nearly always handmade at a far greater cost than will be incurred in ultimate production.

e. The prototype then enters the "Engineering Tests" phase, the object of which is to

determine inherent structural, physical or chemical qualities of the items or system tested, including those of an environmental nature. This phase coincides with the maintenance evaluation of a maintenance engineering prototype as the initial step in maintenance support planning. These tests result in design modifications prior to production. The prototype, or sample of a commercial item already in production, then enters the "Service Tests" phase. Like engineering tests, service tests generate modifications and sometimes even result in a decision not to procure the item. Confirmatory tests of first-run production items are also frequently made by the using agency. This is done to insure that the item being procured performs as satisfactorily as the previously tested prototype and also to determine the adequacy of modifications recommended as a result of the test of the prototype. Service tests are conducted by USCONARC Boards. The results of these tests are forwarded to USCONARC for review and action, and then to the Department of the Army. Tests are of two types—

- (1) *Service test.* A test of an item or system of materiel conducted under simulated or actual operational conditions to determine to what degree the item or system meets the stipulated Military Characteristics, or the suitability of the item or system and its maintenance package for use by the Army.
- (2) *Troop test.* A test conducted in the field for the purpose of evaluating operational or organizational concepts, doctrine, techniques, procedures, or to gain further information on materiel. During each of the above phases there are reviews for maintainability by maintenance engineers.

f. Ordinarily, an item will be type classified by technical committee action prior to its production or procurement. This is the "Type Classification" phase of the life cycle. Items are type classified by the technical service from the standpoint of development and suitability for service. AR 705-6 provides appropriate type classification guidance.

g. The "Production" phase encompasses product improvement and engineering change orders, as well as initial manufacture. During this phase, close attention is devoted to improving or modifying the product.

h. The "Item-in-Service" phase covers several stages. The item might first be assigned to units which are experimenting with new operational tactics and strategy, or it might go directly into operational use. As the item ages, it may be used only for rear-echelon support, or it may be assigned for training.

An item may never see use, and may spend its life in storage.

i. An item's planned in-service life ends when it is type classified as obsolete. Disposal of an item may be by sale, if it has commercial value; by cannibalization, if its parts or components are of value; or by outright scrapping.

j. The term "service life" refers to the period during which an item type is expected to be in the Army supply system; the term "life span" refers to the life expectancy of the individual items within the type.

Section II. MAINTENANCE PLANNING AND MATERIEL DEVELOPMENT FOR MAINTAINABILITY

23. Basic Planning Considerations and Process

a. *General.* The most potent weapon system can become a logistics nightmare without sound planning. The necessity of early and continued consideration of maintenance during development of new materiel is fully recognized. Two maintenance objectives must be met before an item is issued to the ultimate user. First, the item must be planned, designed, and engineered for maximum reliability and maintainability consistent with operational requirements. Maintainability is assured through review by maintenance engineers at specific in-process review points in the development process. Second, materiel development must be accompanied by a maintenance support plan. This plan, prepared by the developing technical service, fixes the responsibility for maintenance operations on appropriate maintenance echelons and insures that each item will be supported by the proper technical skills, repair parts, tools and test equipment, handling equipment, and technical publications, and by effective training and technical assistance programs.

b. *In-Process Review.*

- (1) *Review requirements.* The review of maintenance considerations arrived at during the various development phases of an item constitutes a critical step in maintenance planning. It is the means by which an item can be developed with optimum maintainability features and supported logisti-

cally upon issuance to the field. In-process reviews are conducted as an integral part of the materiel development review program set forth in AR 705-5. The chief of each developing agency must hold these reviews periodically for each item undergoing development for balanced consideration of developmental, procurement, production, tactical employment, and logistics support requirements. These reviews are coordinated with the supporting agency, the using agency, the Chief of Research and Development, and the U.S. Army Maintenance Board.

- (2) *Review points.* If in-process reviews are to be effective, it is vital that review procedures be formally defined and that they begin as early as possible during an item's development. In this way maintenance considerations can be given proper weight in relation to other item characteristics and operational considerations. DCSLOG has formalized a doctrine for holding these reviews which will still permit flexibility among the technical services. This doctrine calls for stated logistics objectives to be given the maximum possible emphasis at various stages of materiel development (AR 705-5).
- (3) *Maintenance objectives.* The maintenance objectives set forth by DCSLOG

stress an elaboration of those called for in preparing a maintenance support plan. They include—

- (a) reliability;
 - (b) reduction in technical skills (quantity and complexity) for maintenance of equipment;
 - (c) use of standard parts, components, modules, tools, and test equipment;
 - (d) interchangeability of parts, components, and modules;
 - (e) accessibility for adjustment and repair;
 - (f) reduction in frequency of repair;
 - (g) use of throwaway components;
 - (h) speed in fault isolation; and
 - (i) reduction in repair time.
- (4) *Review of military and technical characteristics.* DCSLOG screens QMR's to determine their validity with respect to logistics support. A maintenance review is provided when the MR's for a proposed item of equipment are reviewed by USCON-ARC, by the designated development agency, and by DCSLOG.
- (a) The procedures for conducting maintenance reviews vary among the technical services within the broad framework established by DCSLOG. Maintenance engineers from the appropriate NMP collaborate directly with the project designers in incorporating maintainability into design. In some cases maintenance review during the design phase is conducted by research and development engineers. A compromise between these procedures is sometimes reached by having the design engineers furnish maintenance personnel with specifications, sketches, and blueprints for review as they become available.
 - (b) There are certain limitations as to how much maintenance review can be accomplished at the initial design stages or even at the time the first development models or mock-ups have been fabricated. Many

maintenance problems simply cannot be anticipated without being able to test actual end items and their components. A concerted effort should be made at this stage to avoid designing maintenance deficiencies into an item. Many maintenance problems can be averted if design personnel plan for standard parts and tools, concentrate on durability, and blueprint for accessible maintenance, lubrication, and testing points. The decision as to whether to design for use of plug-in assemblies and components rather than individual repair parts can be made on the drawing boards.

- (c) The requirements of the users and the item's design features largely shape the maintenance plan. The original concept of an item is adapted or modified to meet the existing maintenance organization rather than vice versa. Considerations with regard to standardization of parts and components decree that a careful survey be made of the available parts, tools, and test equipment which can be used as a guide in design. The original design requirements may call for maximum lower echelon repairs, when the tools required for such repairs are available only at fourth and fifth echelons. Such a problem would involve an analysis to determine whether the item should be redesigned for lower echelon tools, or whether higher echelon tools should be stocked at lower echelons. The whole process of maintenance data collection and analysis will continue throughout the development cycle. The sooner this process can begin, the greater is the chance of completing it before the item is released for production.
- (d) Maintenance engineers must develop an effective procedural relation with research and development personnel, and foster a receptive

audience at the development agency. Maintenance is not an appendage to, but rather an integral part of, an item's design. Initial maintenance reviews are likely to be informal in nature, and the final decision as to whether or not to accept a maintenance recommendation generally rests with the designer.

- (e) The detection of a maintenance problem does not necessarily insure that a solution will be attained. Maintenance must compete against other pressing military requirements of performance, size, and weight. The growing emphasis on airborne equipment has imposed heavy burdens on maintenance. The necessity for compactness often results in reparable components being jammed into inaccessible spots and lubrication points being obscured. Similarly, a maintenance recommendation for a more durable part may be overridden by a strategic or critical material ban.
- (5) *Final preproduction reviews.* One of the most critical points in maintenance planning, particularly the physical evaluation or product review phase, occurs after completion of full-scale development prototypes and subsequent engineering and test models. These hand-tooled models generally contain the same materials which will be used in regular production, thereby lending themselves readily to study and testing.

c. Determining Need for Maintenance Support.

- (1) The nature of the maintenance support plan developed for a new item depends on the maintenance concept adapted. There must first be a determination as to whether the item should be supported. It is neither necessary nor desirable to provide maintenance support for every item or its major components. In many instances items are considered to be

expendable even though they are reparable. The cost of supporting an item with an elaborate maintenance organization may exceed the cost of buying a completely new item to replace it when it becomes unserviceable.

- (2) The degree of maintenance support considered desirable varies with items, operators, maintenance organizations, and theaters. In the development or procurement of most new items, it is necessary for the responsible technical service to undertake a comprehensive study to determine what maintenance support should be provided. Such a study must consider the basic design configuration of the item itself, the replacement costs for the item, the estimated service life of the item type and the life span of individual items of the particular type, the number and types of repair parts required and available, and the skills, time, and facilities necessary to support the item.
- (3) Consideration of both the service life and the life span for a new item is basic to a determination of the maintenance which will be required to support it. These factors significantly affect provisioning of repair parts, the allocation of maintenance operations to the various echelons, and the standards to be applied in establishing maximum economic repair limits. The estimated life span of an item may be based initially on historical data, on wear-out rates of similar models or types of equipment, or on engineering estimates. Initial estimates are revised generally in accordance with actual experience data. Estimates of service rest primarily on anticipated strategic and tactical requirements and on the prospect of technological advances. Consideration of all these factors and enumeration of those which affect maintenance support are included in what is known as the maintenance concept.

24. The Maintenance Support Plan

a. *Developing a Support Plan.* The technical service responsible for developing a new item, or for procuring a commercial item must insure that the item not only can be supported, but that it will be supported. Each technical service is required by DCSLOG (AR 750-1) to initiate preparation of a maintenance support plan for each item of materiel which it develops or procures. To develop this plan, the item must be reviewed (maintenance evaluation) prior to production (normally at the time of engineering test) with respect to the following considerations:

- (1) Determination of the preventive and corrective maintenance that will be required, the frequency of maintenance, and the ease of performing it.
- (2) Allocation of maintenance operations to the lowest appropriate echelon based on the maintenance concept of support, plus—
 - (a) skills, required, and available;
 - (b) time required for maintenance;
 - (c) requirement for standardization and interchangeability of parts and components;
 - (d) tools and test equipment required (special or common);
 - (e) mission of the intended user; and
 - (f) MOS structures, POI's, TOE's, training, training aids, and facility requirements to insure that trained maintenance personnel are available to support the end item when it is issued to the troops in the field.

b. *Nature of the Plan.* An analysis of the above considerations indicates that the maintenance plan is essentially a composite program for supporting an item in service. To develop such a composite program for the maintenance and repair parts support of an item, the technical service must do more than physically examine prototypes and test models. It must first determine a maintenance concept for the item, then collect and collate information on the planned service life of the item type and the expected life span of each individual item. It must ascertain the item's projected use and

users, the availability of standard and interchangeable parts, the publications required to support the item, the training and technical assistance programs which will be necessary, and the capabilities of the existing maintenance structure for accomplishing anticipated repairs. Based on these considerations and data obtained by maintenance engineers during maintenance evaluation an effective support plan can be prepared. The maintenance support plan is initiated upon establishment and development of a procurement project and kept current throughout the development and procurement stages of an item. It includes preparation of a maintenance allocation chart (MAC), which assigns maintenance functions and repair operations to be performed by each appropriate maintenance echelon. It also makes provisions for appropriate technical manuals with appended parts, tools, and test equipment lists, as well as other pertinent technical publications. That part of the plan to include allocation of first and second echelon functions and publications and parts appendixes for first and second echelons is completed and collated in preliminary draft form—called the maintenance package—for evaluation during service test.

c. *Nature of the Maintenance Package.*

- (1) DCSLOG requires each technical service to prepare a Maintenance Package for every item of materiel which it develops or procures for service test. This package consists of preliminary drafts of—
 - (a) the maintenance allocation chart(s) (MAC);
 - (b) the list of repair parts and special tools authorized for use in organizational maintenance;
 - (c) Parts I and II of the technical manual(s); and
 - (d) lubrication order(s).

Preparation of draft material for the Maintenance Package is based upon a physical review or teardown of a model of the item. This model should be an engineering prototype, or in the case of commercial items, it may be a preproduction model (AR 750-6). The regulations specifically stipulates

that the technical services will insure that an appropriate model is made available to maintenance engineers in sufficient time to permit physical review or teardown and preparation of the Maintenance Package prior to service testing.

- (2) Maintenance engineers in the case of mechanical equipment conduct a complete disassembly and reassembly of the item and its major components, using the tools normally assigned to each maintenance echelon. This breakdown enables maintenance personnel to spot inaccessible lubrication points and components, areas likely to unnecessarily collect abrasive dust or moisture, parts subjected to undue friction, and points vulnerable to severe stress and strain. It also reveals what parts, tools and test equipment are required to support the item.
- (3) As a consequence of the judgments reached during the maintenance evaluation, maintenance personnel in conjunction with repair parts specialists, prepare drafts of the maintenance allocation charts for the item. These charts fix the echelon authorized to perform each maintenance operation, on the basis of the skills available, time required, and parts, tools, and test equipment required or available.
- (4) The maintenance allocation chart format has been standardized (AR 750-6). The components listed in column 2 of the chart would be those applicable to the end item which were susceptible to maintenance. Column 2 also indicates whether the component would be serviced, adjusted, inspected, tested, replaced, repaired, aligned, calibrated, overhauled, or rebuilt. Columns 3 through 8 indicate the echelon(s) of maintenance authorized to perform the operation indicated in column 2. An "X" in these columns would only indicate the echelon responsible for the particular maintenance operation; it would not necessarily indicate parts stockage at that level. The symbol "% %" which may be placed only in

the second-echelon column, indicates that second echelon may perform the particular maintenance function, provided that the request originates from an organizational level and is specifically authorized by the direct support technical service officer. Columns 4 and 5 provide for further breakdown of second-echelon maintenance responsibilities, i.e., company and battalion. If column 9, "Tools Required," were used, a list of individual tools or test equipment would be attached. Column 10 is used for cross-reference of a particular maintenance function to special explanatory notes or illustrations required, which would be attached as an inclosure to the chart.

- (5) Repair parts selection and allocation for an item are based on the maintenance allocation chart.
- (6) Finalized maintenance allocation charts will be included in part II of the appropriate technical manual for the item (AR 310-3).
- (7) The final maintenance evaluation will determine the most effective and economical form of supply repair parts to be used in each operation and echelon, that is, individual items, parts kits, plug-in units, and subassemblies.
- (8) The formal preservice test maintenance evaluation should be conducted by maintenance engineers at the appropriate National Maintenance Point in conjunction with repair parts representatives, packaging engineers, and tool and test equipment specialists from either the NMP or the appropriate National Inventory Control Point. In such cases, recommendations are forwarded to research and development and to production (or industrial) engineering for consideration. The maintenance review is part of a formal product review which is conducted jointly by representatives from research and development, industrial engineering, parts, and maintenance activities. The item is studied in terms of producibility, use of standard components, conservation of critical

and strategic materials, ease of maintenance, and reliability. Subsequently, the complete maintenance package, together with the end item and all accessories, special tools, and repair parts required to maintain it, is made available to the appropriate service or troop test agencies for evaluation and service or troop tests. These tests, which are conducted under simulated, or in the case of troop tests, actual operating conditions, usually are invaluable to maintenance, as many deficiencies do not become apparent until the item has been tested in the field. These tests may indicate the need for re-echeloning certain maintenance functions. In some cases, maintenance engineers actually work with the item during field tests, but more often the National Maintenance Point or equivalent sends service test questionnaires to USCONARC. Time pressures, however, may limit the value of test evaluations; on crash programs, the test phase may not be completed until after initial production commences.

- (9) Concurrently with the development and test of materiel, service schools and NMP's responsible for training maintenance personnel examine the existing MOS and training structure to determine what revisions or addi-

tions, if any, may be necessary to properly support the new item. The service schools determine quotas for any schools which are to be conducted by the contractor or technical service in regard to new equipment. The National Maintenance Points determine the special requirements for manufacturers representatives and further school training of technical service personnel.

- (10) AR 750-6 prescribes that representatives from the following agencies will meet for the purpose of finalizing the maintenance package: the technical service agencies responsible for developing the end item and the maintenance package, appropriate technical service schools and service test agencies, appropriate USCONARC service schools and test agencies, and the U.S. Army Maintenance Board.
- (11) The U.S. Army Maintenance Board mediates points of dispute for DCSLOG which cannot be settled by mutual agreement between the technical services and USCONARC representatives. In disputes involving only technical services, USAMB representatives will mediate only on points between two or more technical services. Unresolved disputes are finally settled by Department of the Army.

Section III. REPAIR PARTS PROVISIONING, ALLOCATION, AND ALLOWANCES

25. Provisioning Objectives

a. The effectiveness of a maintenance support plan depends greatly upon sound provisioning. Initial provisioning is the process of determining the range and quantity of items (i.e., repair parts, maintenance tools, test equipment and support equipment) required to support and maintain an end item of materiel for an initial period of service. This is the point at which the basic supply pattern for maintaining an item is established. Subsequent field use, technical improvements, and particular supply exigencies may alter this pattern for purposes of followon provisioning, but the importance of the initial decisions must be emphasized. This

is particularly true of provisioning for end items new to the supply system, where selection may depend largely on the foresight of those performing the maintenance evaluation and environmental prediction study on the item.

b. The chief purpose of initial provisioning is to procure maintenance support items, including repair parts, concurrently with the new end items in order to insure support between the time of end-items issue and the time when experience supply data are firm enough to permit procurement by normal replenishment methods. The formal initial provisioning process is ordinarily accomplished after user tests and final engineering and maintenance evalua-

tions on the production model have been made and prior to production of the end items. This does not preclude limited procurement of organizational and certain field maintenance parts and other equipment necessary to support an item during its tests. Long lead-time support items may also be procured in advance of approval of the production model. This type of procurement, however, basically follows the regular provisioning requirements for documentation and evaluation.

c. Like the development of maintenance allocation charts, initial provisioning involves both a physical appraisal of the item, together with its components, and a study of its future environment. The existing supply system is examined carefully to determine parts common and parts peculiar; the maintenance structure is studied with respect to its capabilities; the merits of stocking assemblies and components as opposed to individual parts are weighed; and the item is ultimately source coded. Source coding indicates the best method or source of supply for the selected part, the lowest echelon of maintenance capable of installing or manufacturing the repair part, and the recoverability aspects of the part. Allocations and allowances of the required repair parts are also made; the parts chosen for stockage are published in appendixes to the technical manuals. A similar process for provisioning is followed with test and other maintenance support equipment, which are also listed in the appendixes to the technical manuals.

26. Provisioning Process

a. *Preliminary Provisioning for User Tests.* The provisioning process actually begins well before the formal initial provisioning is undertaken for quantity procurement of items to

support the production end items. In preparing the maintenance package for user tests it is necessary for the developing agency to draw up a repair parts list, as well as lists of special tools and test equipment for organizational maintenance. This insures that the user test agency will have a small quantity of parts on hand in order to carry out the required tests. It also enables the developing agency to test the validity of the preliminary parts selection.

b. *Initial Provisioning Schedule.* The technical services issue provisioning procedures for materiel within their cognizance. These procedures call for establishment of a provisioning schedule to insure that complete provisioning documentation, necessary provisioning conferences, and ultimate delivery of repair parts are scheduled in consonance with the end-item delivery schedule. The provisioning schedule defines the tasks to be performed by both the contractor and the Army agencies concerned and provides a related time schedule. In accordance with the schedule, the contractor must furnish technical provisioning documentation necessary for parts identification, determination of requirements, cataloging, and contractual formalization. It includes a provisioning list, priced repair parts list, and supporting documentation in the form of drawings, schedules, and item descriptions. The technical service may also call for a long-lead time items list, to be filed in advance of approval of a production model. It may also request a Vendor Item's List on commercial parts and often a list of bulk items required for maintenance and overhaul. The format for all lists is designated for manual preparation or for use on electronic data processing equipment (EDPE).

c. The following is a typical technical service provisioning schedule:

Action	By	Timing
Submission of provisioning documentation scheduling letter.	Contractor	Within 30 days after receipt of award.
Preprovisioning planning conference.	Government	Within 30 days of provisioning documentation scheduling letter.
Request for authorization and submission of data for long-lead parts.	Contractor	15 days prior to ordering long-lead production parts.
Reply to request for long-lead parts.	Government	Within 15 days of receipt of request.
Submission of provisioning documentation.	Government	Not later than 45 days prior to ordering production parts or concurrent with submission of preproduction sample (whichever is earlier).

<i>Action</i>	<i>By</i>	<i>Timing</i>
Acknowledgment of receipt of provisioning documentation.	Government	Upon receipt of provisioning documentation.
Submission of revisions to provisioning documentation.	Contractor	As required subsequent to submission of provisioning documentation.
Provisioning conference.	Government	Not later than 45 days after receipt of acceptable provisioning documentation.
Submission of repair parts advice with repair parts exhibit.	Government	Not later than 45 days after receipt of acceptable provisioning documentation.
Submission of priced repair parts exhibit with pricing data.	Contractor	Not later than 120 days prior to initial delivery of end item.
Submission of shipping instructions with stock numbers.	Government	Not later than 45 days prior to initial delivery of end item.
Contract modification defining repair parts requirements.	Government	Not later than 15 days prior to initial delivery of end item.
Delivery of repair parts.	Contractor	Concurrent and proportionate with the end item.

27. Provisioning Criteria

a. The selection of repair parts is predicated on the maintenance allocation chart. The actual selection is accomplished by physical examination of the entire end item and its parts, and a review of parts drawings. Mortality rates on similar end items already in use are considered, as is the relation of a part to a higher component and to the end item. In arriving at parts to be selected for ultimate provisioning, the process of elimination is very useful. By following established criteria for not selecting a part, it is relatively easy to achieve a parts list for selection. The criteria for nonselection are—

- (1) production items, the mortality of which is below the frequency of the reclamation of the major item or the component on which used;
- (2) parts that can be fabricated by organizational, field, and depot maintenance units; and
- (3) items that a maintenance evaluation has determined are more advantageous to supply as an assembly, as a combination of assemblies, or as a component of kits or sets.

b. The range of parts selected for initial provisioning is limited to organizational and field maintenance repair parts required in the first full year of operation. This includes parts initially required in service schools for training purposes. Slow-moving, nonfunctional repair parts and parts required for maintenance support beyond the first year's quantities of the end items will not be procured (AR 700-19).

c. The quantities of selected repair parts required are based not only upon regular supply stockage objectives to cover initial distribution to using units (AR 700-18) and stockage at oversea and CONUS depots (AR 11-8 and AR 710-25), but upon maintenance and engineering data as well. These include programed or estimated hours or miles of operation, the programed physical environment, the skill of operators, the quality of expected preventive and organizational maintenance, and other conditions under which the end item will be operated. Deviations from both range and quantity criteria must be approved by DCSLOG.

28. Repair Parts Allocation and Allowance

a. *General.* The repair parts originally selected for the maintenance package and refined during provisioning must be allocated by the technical service to the appropriate maintenance echelon; source codes must be prepared and allowance factors and initial guide quantity lists established. The final allocation is usually made after user tests and is based upon the revised maintenance allocation chart. It reflects the maintenance and support capabilities available at each echelon and the complexity of each repair operation. The codes, allowances, and initial guide quantity lists are published in technical manual appendixes.

b. *Army Repair Parts Source, Maintenance, and Recoverability Code.*

- (1) Army Source Coding as defined in AR 700-18, is a method devised to indicate—

- (a) the parts selected to satisfy maintenance or repair requirements;
 - (b) the most efficient and practical source or method of supply for the selected repair part;
 - (c) the lowest echelon of maintenance capable of installing or manufacturing the repair part; and
 - (d) the recoverability aspects of the repair part.
- (2) Army Source Code symbols are as follows:
- (a) Code "P"—applied to repair parts which are high mortality parts, procured by technical services, stocked in and supplied from the technical service depot system, and authorized for use at indicated maintenance echelons.
 - (b) Code "P1"—applied to repair parts which are low mortality parts, procured by technical services, stocked only in and supplied from technical service key depots, and authorized for installation at indicated maintenance echelons.
 - (c) Code "M"—applied to repair parts which are not procured or stocked, but are to be manufactured by using units at indicated maintenance echelons.
 - (d) Code "A"—applied to assemblies which are not procured or stocked as such, but which are made up of two or more units, each of which carries individual stock numbers and descriptions and is procured and stocked and can be assembled by units at indicated maintenance echelons.
 - (e) Code "X"—applied to parts and assemblies which are not procured or stocked, the mortality of which is normally below that of the applicable end item, and the failure of which should result in retirement of the end item from service.
 - (f) Code "X1"—applied to repair parts which are not procured or stocked, the requirement for which will be supplied by use of the next higher component assembly.
 - (g) Code "X2"—applied to repair parts which are not stocked. The indicated maintenance echelon requiring these repair parts will attempt to obtain them from salvage; if not obtainable from salvage, the repair parts will be requisitioned with supporting justification through normal supply channels.
 - (h) Code "C"—applied to repair parts authorized for local procurement. If not obtainable from local procurement, these repair parts will be requisitioned through normal supply channels with a supporting statement of nonavailability from local procurement.
 - (i) Code "Z"—applied to obsolete repair parts no longer stocked or procured.
- (3) In using these codes to classify an item, two other symbols are added; they represent the echelon authorized to install the part (and, if applicable, to fabricate it) and the recoverability status of the part. The following code symbols are used to indicate the lowest maintenance echelon authorized to install and, where applicable, to manufacture "M"—coded repair parts.
- (a) Code "O"—first and second echelon
 - (b) Code "F"—third echelon
 - (c) Code "H"—fourth echelon
 - (d) Code "D"—fifth echelon
- (4) When repair parts have been designated as recoverable items, the appropriate code symbol listed below is used:
- (a) Code "R"—applied to repair parts and assemblies which are economically repairable and, when available, are furnished by supply on an exchange basis.
 - (b) Code "S"—applied to repair parts which may be placed in stock ready for issue condition by cleaning, replating, anodizing, adjusting, welding, and so forth.
- c. Mortality Rates.*
- (1) Mortality rates are estimates worked out by maintenance engineers of the

rates of failure of a particular part or component. The rates are a crucial factor in deciding the initial stockage of the item in the supply system: They determine whether or not a part will be stocked.

- (2) The part that will outlive the end item it supports obviously will not be stocked. The part that wears out infrequently is difficult to justify for stockage. If the end item is high-value, and the part low-value, it may be necessary to buy and stock the part despite the fact that it seldom wears out. Certainly this is necessary in the case of a vital military item, since military criticalness is the overriding consideration at any time.
- (3) The importance of mortality rates is apparent; the difficulty in establishing them may not be so clear. The mortality rate experienced previously by a similar item is a helpful gauge for rating a new item; however, it can only serve as a general guide. The new item may have been devised solely to correct the deficiency that led to high mortality rates in the old. In any case the new item will probably have features not found in the old. It may be greater or less complex or made of different material. If these changes are organic—that is, if they directly affect the functioning of the part—the item will be subject to varying and different stresses. Nonetheless, the existence of a similar item is of considerable help in establishing mortality rates for new part.
- (4) For entirely new parts, the problem is much more complex. With no “like item” histories to supplement technical knowledge, those performing maintenance reviews on the item must consider every factor that is likely to have a bearing on the item’s resistance or susceptibility to failure and wearout. These considerations include stress, friction, climatic conditions, use of the end item, skill of the user, delicate or balanced elements, hours of use, terrain, and so forth. The technical

knowledge, personal experience, and judgment of those performing the evaluation are of maximum value at this point.

d. Allowance Factors.

- (1) Allowances of the number of each repair part authorized at the first four maintenance echelons are computed on the basis of consumption rates. The allowance factor represents the estimated average quantity required to support maintenance operations for organizational and field maintenance for a hundred equipments for 15 days at combat rates of consumption. The quantity established for depot maintenance needs is based on a need per hundred items, and represents one hundred items to be overhauled rather than supported. Allowance factors are based on all available data, such as manufacturer’s recommendations; engineering, service, and troop test results; and experience with other similar items. When the item has been in use long enough to warrant study of its performance, the data collected from such a study may necessitate revision of the allowance factor.
- (2) The items selected for organizational maintenance allowances will normally be the following:
 - (a) Those repair parts for which the allowance factor is large enough to authorize stockage of a quantity of at least one in a majority of the units and organizations authorized the major end items.
 - (b) Those repair parts (combat essential items) for which the allowance factor is not large enough to authorize a stockage in a majority of the units and organizations authorized the major end items, or in third-echelon support activities, but the failure of which can be expected occasionally and will deadline major end items essential to the operational mission of the unit or organization (ch. 17).
- (3) Initial guide quantities are also estab-

lished for repair parts allocated to field and depot maintenance units. Those quantities for field maintenance represent initial stockage necessary

for a 15-day supply. Both field and depot stockage lists are subsequently revised to reflect demand data (chs. 11 and 16).

Section IV. CHANGES IN PRODUCTION ITEMS

29. General

The impact of crash programing on maintenance evaluation and planning has been stressed. Even under so-called normal conditions, the testing—maintenance evaluation—engineering change cycle usually runs through the production stage. It is questioned whether, in the final analysis, it really matters when the maintenance evaluation is completed, provided that all necessary changes and planning are accomplished before the item sees active service. The answer to this question has been painfully obvious to maintenance. Industrial engineers are even less responsive to maintenance proposals than are design engineers. Once production is underway, it is no longer a matter of effecting a major change by a stroke of a designer's pen. Changes during production may involve retooling, rearranging assembly lines, or canceling parts contracts and ordering new components. In some cases the designers may have to be called back into the picture. Modifications to items already produced are also time-consuming and expensive. This problem, which is a byproduct of rapid technological advances and international crises, does not lend itself to any pat management solution; an appreciation of its seriousness may in fact cause a reappraisal of some unnecessary project telescoping.

30. Testing and Engineering Changes

a. Theoretically, the testing phase should be virtually completed before production starts, but industrial engineers usually find it necessary to run engineering tests on production pilot models in order to take account of the almost inevitable differences between handmade prototypes and the production item. Service tests generally continue into the production stage. Using agencies are usually anxious to operate with the actual item, and again there is

the timing problem. Many tests such as climatic and endurance tests, cannot be completed until production has begun. For extensive testing it may be necessary to produce a number of pilot models. Another factor which may cause extension of testing is that engineering changes, made because of unforeseen production difficulties, may require further tests to establish their validity. Any continuation of the testing phase, particularly service tests, must be closely monitored by maintenance.

b. Any deficiencies, regardless of their nature, may result in submission of an Engineering Change Request (ECR) or Engineering Change Proposal (ECP) by the end item manufacturer, or by the developing or testing agency. Implementation of an ECR or ECP is generally the responsibility of the Industrial or Procurement Division of the appropriate technical service. ECR's and ECP's are coordinated with repair parts representatives to insure that necessary changes in parts selection and allocation are made. They are usually forwarded to the responsible maintenance agency for an evaluation to determine what effect they will have on maintainability. A major engineering change or modification not only may affect parts, but also may entail retooling and revision, or supplementation, of supporting maintenance publications and other revisions to the maintenance support plan.

c. Upon approval by the appropriate technical service agency, an ECR or ECP is issued as an Engineering Change Order (ECO). Engineering changes or modifications which may involve changes to established Military Characteristics require technical committee action and approval by the DCSLOG. In the event that some of the items are already produced or in service, a Modification Work Order (MWO) may also be issued directing necessary modifications to be made in the field by the appropriate maintenance echelon.

Section V. MAINTENANCE POLICIES GOVERNING ITEMS IN SERVICE

31. General

a. The major portion of maintenance is performed in support of items in service. It is during this time that the validity of maintenance planning is tested and the basic policies explicitly aimed at supporting the item in use are acted upon. These policies, which deal primarily with measures to improve maintenance and supply performance, are set forth in Army regulations and reinforced by the DCSLOG, the technical services, USCONARC, and field army directives.

b. Many of the policies relative to in-service periods have their basis in decisions made during the development stages when certain maintenance characteristics are built into an item. The current policy favoring direct exchange or repair by replacement in the field could not be implemented unless modularization techniques had been employed during design and engineering. This emphasizes the fact that overall maintenance concepts must be developed for materiel maintenance in general and for individual items in particular. Lacking fundamental maintenance concepts and sound maintenance support plans, the policies and programs relative to in-service life have little meaning.

c. The broad objectives toward which specific maintenance policies are directed include—

- (1) reducing required maintenance;
- (2) reducing maintenance actions;
- (3) improving maintenance performance;
and
- (4) improving supply performance.

32. Reducing Required Maintenance

a. *General.* This objective is attained primarily by policies and programs exercised during materiel development stages, when steps are taken by R&D and maintenance engineers to increase reliability and maintainability and thereby decrease required maintenance. After an item is issued other steps can be taken which can appreciably reduce required maintenance. These include improved training of operating personnel, optimum performance of preventive maintenance, decreasing “nice-to-have” modifications on older types of equipment, and the

development of firm and accurate economical repair criteria and maximum expenditure limits. The last of these is the area in which the greatest reductions in maintenance can be attained and in which more uniform and realistic policies must be established.

b. *Maximum Expenditure Limits.* An explicit objective of the current Army Materiel Program is the removal of uneconomically repairable equipment from the supply system. As a byproduct, this will also expedite the Army's modernization program. New items will be more economical to support in the logistics system and will generally have operational performance characteristics superior to their predecessors. The Department of Army has directed the technical services to develop maximum allowable one-time and cumulative expenditure limits for each category and type of equipment. It has also directed the formulation of “no rebuild lists” for obsolete and non-standard items. The factors governing the development of repair and overhaul limits include age, usage, reliability, life expectancy, storage life, transportation costs, repair parts support status, military criticality, cost of repair, and cost of replacement. The technical services have provided different methods of inspection, compatible with the nature of their equipment. As a general rule, one-time direct and indirect repair costs may not exceed 65 percent of the item's standard price (as reported in the Army Standard Price Guide). Deviations from this general rule must be allowed by Department of the Army, when there is no replacement in depot stocks or production as this may impede operational efficiency, especially overseas. Notwithstanding the existence of many variations and factors in establishing limits on different item types, or the necessity for occasional deviations, every effort must be made by each technical service to prescribe meaningful repair limits and insure adherence to them.

33. Reducing Maintenance Actions

a. *IROAN.* Inspect and Repair Only as Necessary (IROAN) is a maintenance technique. It implements the principles of economical maintenance operations by assuring

thorough diagnosis of major items and components before repair or replacement. Unwarranted disassembly and uneconomical tear down is precluded by use of soundly engineered technical inspection procedures, and/or by use of diagnostic and troubleshooting tools. Time-consuming and costly labor operations are held to a minimum by maintenance supervisory personnel through the use of work simplification, procedure analysis, and time performance standard programs. This technique does not preclude essential disassembly, it only eliminates unessential disassembly. Serviceability standards for the components and/or major item involved must not be compromised through the practice of the IROAN technique.

b. Depot Maintenance Policies. Basic policies directed toward reducing depot maintenance include—

- (1) relating overhaul programs of CONUS and oversea depots to the location and availability of worldwide inventories of serviceable assets and to total supply requirements;
- (2) requiring that field maintenance be performed at field maintenance activities, not at depot maintenance shops;
- (3) utilizing cross-servicing facilities whenever possible;
- (4) employing commercial repair facilities to the maximum extent possible consistent with Army operational, mobilization, and training requirements; and
- (5) eliminating depot maintenance of items that can be more economically replaced by a new like item.

c. Field and Organizational Maintenance. In organizational maintenance a prime objective is to increase the intervals between periodic preventive maintenance inspections and also between preventive maintenance services. Most technical services have revised their inspection and maintenance servicing policies and procedures accordingly. Similar measures have been undertaken throughout the field and organizational maintenance systems to reduce maintenance inspections by application of sampling techniques. Other policies in field maintenance designed to reduce maintenance performed include—

- (1) expansion of commercial contracting in CONUS on nontactical equipment;
- (2) increasing the use of repair by replacement with throwaway modules;
- (3) exploiting use of cross-servicing; and
- (4) performing organizational maintenance for using TOE units only to the extent that it is regularly beyond the capability of the using units.

34. Improving Maintenance Performance

a. General. Maintenance policies supporting this broad objective are chiefly directed toward achieving better personnel training and utilization; applying management control devices in programing, budgeting, scheduling, funding, and operations; strengthening technical assistance and information programs; and improving maintenance organization.

b. Personnel. Army maintenance policies in this area are aimed at improving maintenance training and utilization. In this period of austerity in the Army, it is necessary to make better use of available resources. This is accomplished by insuring that enlisted maintenance personnel attend service schools and new equipment schools whenever possible. Civilian management and officer personnel should be trained at maintenance management programs conducted at the U.S. Army Logistics Management Center and at civilian institutions, and, in the case of senior officers, at the Senior Officers' Preventive Maintenance Course. On-the-job training for all personnel should be provided to meet specified training objectives; it should not be provided on a haphazard basis but should be accomplished within a specified period. In the area of personnel utilization, closer scrutiny must be given to—

- (1) preparation of TOE's in order to relate the skill with the assignment more effectively;
- (2) assignment of personnel with critical skills on a priority basis; and
- (3) maximum use of personnel within an activity and avoidance of unrelated, unnecessary duties.

c. Management Controls. The Army has introduced management control systems designed to improve control over its resources of

personnel, money, and materiel. Specific policies prescribe various systems and reports pertinent to maintenance management which provide for more valid programing, budgeting, and scheduling; better evaluation of resources employed; and more accurate measurements of maintenance performance. Current Army logistics policy calls for maximum use of any control which will increase maintenance management capabilities. Optimum use of the principal of "management by exception" should be employed in the use of controls.

35. Supply Support

a. Army policies on the supply support of in-service items are contained in FM 38-1. This manual deals only with supply policies and programs as they pertain directly to maintenance (chs. 11 and 16). Basically, Army supply policies in support of maintenance operations are designed to insure prompt and economical supply of repair parts, tools, and test equipment to maintenance. The promptness with which the supply system meets maintenance demands depends not only upon efforts of supply points, but also upon the efficiency of maintenance units in routing demands to supply sources and giving advance notice when heavy workloads are anticipated. The economy of the overall Army supply system depends to a great extent on the adherence of maintenance activities to the stockage levels authorized at their shops. Though they may be temporarily convenient for an individual shop, violations of authorized levels can only result in a hardship to other maintenance activities.

b. One supply policy which is especially applicable to maintenance management is the emphasis on controlled cannibalization. Cannibalization of unserviceable, uneconomically repairable equipment is to be accomplished by maintenance units at designated cannibalization points to obtain high dollar value, low mortality repair parts, subassemblies, and components. It is generally not economic to obtain low value items through controlled cannibalization because of the cost of recovery.

36. Maintenance Considerations Relating to Obsolescence and Disposal

a. There are several methods of disposing of an unserviceable item in order of preference once it has become uneconomically repairable or been declared excess. It may be shipped to a cannibalization point, supply point, or maintenance shop stripped of any of its components which are still serviceable; and then sold for scrap. It may be sold on the spot as an unserviceable item which nevertheless is a complete unit in that it contains all of its component parts. In cases of extreme deterioration and damage, it may be sold as scrap on a per-pound basis.

b. The procedures for disposal of excess or uneconomically repairable Army equipment have been standardized for all technical services and commodity groups. The AR 755-series contains detailed procedures for disposal of varying types of equipment. However, the disposition of property, *per se*, is not a maintenance responsibility.

CHAPTER 4

MAINTENANCE SUPPORT

Section I. TECHNICAL AND CONTRACT ASSISTANCE

37. Introduction of Items

With the entry of an item into the supply system, the importance of maintenance to the item rises geometrically. The users and maintenance personnel must be instructed in its operational and maintenance requirements and procedures by instructor-technicians and by technical publications. Maintenance engineers at National Maintenance Points must keep abreast of equipment failures and provide for prompt corrective action, either field fix or redesign. Through command and technical inspections, field commanders and their technical service staff officers must insure that the maintenance support system is operating at maximum efficiency. Without proper maintenance support and supervision in the form of technical assistance programs, publications, equipment failure reporting and analysis, and inspections, the various maintenance echelons would have to assume a workload which might strangle this critical link in the Army's logistics system.

38. Technical Assistance

The introduction of new items into the supply system creates a training problem. This problem is a continuing one; it does not end with the initial training of maintenance personnel and users in the item's operation and maintenance. Unexpected problems encountered in the use of new items often develop during actual service, and modifications become necessary. The item may be used to perform tasks not initially anticipated, and reecheloning and revision of maintenance operations may be effected. Accordingly, the Department of the Army has supplemented the regular maintenance training program with a technical assistance program and has assigned responsibility for its execution to the technical services. Technical assist-

ance is afforded through four media: regional maintenance representatives; maintenance technicians; manufacturers' representatives; and contract field technicians. The common functions of these technicians include—

a. assisting in the introduction of new equipments into the field, and familiarizing and training using activities in appropriate operation, inspection, and maintenance techniques for such equipments;

b. surveying equipments in use to detect unsatisfactory performance and incipient operational failures and deficiencies;

c. reporting such deficiencies and failures to the cognizant technical service and to the manufacturer of the equipment to enable prompt initiation of appropriate corrective action;

d. recommending action to improve maintenance service and repair parts support of Army equipments; and

e. serving as a point of contact and as a means of disseminating maintenance information for all military users of specified materiel within assigned areas.

39. Regional Maintenance Representatives

a. Since the depot system is the apex of technical service maintenance operations, much of the technical assistance program is provided through this system. Regional maintenance representatives (RMR's) attached to various technical service depots and technical service sections of general depots make periodic advisory visits to maintenance activities in CONUS and overseas for the purpose of providing technical assistance. Their affiliation with the depots often enables these representatives to bring a fresh perspective to field and organizational maintenance problems.

b. These representatives frequently perform field reviews on specific items and, when requested by the user of the equipment, aid him in preparing unsatisfactory equipment reports (UER's) to be submitted to the technical service headquarters on unsatisfactory performance, design of materiel, maintenance publications, or procedures. (See AR 700-38 for procedures in filing UER's, and AR 700-39 for procedures in filing Electronic Failure Reports EFR's.) They assist in inspecting materiel, when requested, for the purpose of determining economic reparability. When evacuation to higher echelons appears necessary, they may be of assistance in setting up an evacuation plan between the field and the recipient depot.

c. RMR's must scrupulously avoid interfering with normal command prerogatives. Accordingly, procedural or technical changes considered necessary are proposed to the command as recommendations through technical service channels for subsequent formalization and submission back through proper Army command channels. Reporting to higher echelons also serves the important function of disseminating a particularly valuable proposal throughout the maintenance community.

d. On a periodic or request basis, the RMR's in CONUS make visits to overseas commands. Overseas visits are arranged through the technical service headquarters, although in some technical services this done by direct liaison between the overseas commanders and the appropriate regional maintenance office. The application of this program from CONUS depots to overseas commands is considered an effective means of providing a link with CONUS distribution depots. They assist in the final preparation for overseas movement (POM) inspections and then are able to observe their ultimate effectiveness from an overseas vantage point.

e. The technical services provide for a reporting system in this program to insure that appropriate commands know what problems exist and be able to initiate necessary corrective action. Reports normally are submitted to the regional maintenance office, the command concerned, the major overseas commander, the appropriate ZI army headquarters, and the chief of the responsible technical service.

40. Maintenance Technicians

a. Maintenance technicians are military personnel or civil service employees who are hired, trained, and supervised by the technical services. These technicians are furnished to operating commands from the responsible National Maintenance Point, technical service headquarters, or technical service depot. Maintenance technicians may be assigned to CONUS, overseas, or to MAP countries, although some technical services restrict their assignment to CONUS. In many cases they are associated with the technical service maintenance training program since their basic concern is to advise operators and lower-echelon maintenance technicians in specific technical methods.

b. In the course of their duty in the field, these technicians may assist equipment users in submitting UER's and also may render assistance in applying modification work orders. In CONUS, they generally provide assistance to first and second echelons; in overseas commands and MAP countries, they often serve higher maintenance echelons. Whereas RMR's function only in an advisory capacity, maintenance technicians are more closely integrated into the unit to which they are attached.

41. Manufacturers' Representatives

a. Technical assistance on new equipment operation and maintenance techniques is often afforded by manufacturers' representatives, who are employees of the equipment manufacturers involved. Their services are generally provided for under the applicable procurement contracts for the end items. Their mission is twofold: to instruct operators and maintenance units in proper operating and maintenance procedures; and to provide the technical services and the manufacturer with on-the-spot reports of equipment performance.

b. Manufacturers' representative services ordinarily do not extend more than 2 years after an item is distributed to the operating commands; their assignment may be overseas as well as in CONUS, depending on the density of use or peculiar operating conditions such as combat, terrain, or climate. They are assigned by the technical services in coordination with the operating commands that provide for their administrative support.

42. Contract Field Technicians

a. Contract field technicians are employees of manufacturing, engineering, or consulting firms whose services are obtained by the technical services through nonpersonal service contracts. The services are ordinarily obtained when a demand for certain technical skills exist which are not readily available within the Army. The use of contract field technicians has become a part of the technical assistance program in support of new or modified highly complex equipment.

b. The primary mission of contract field technicians is assistance. They report directly to the responsible technical service rather than to their parent organization. Any advice or information they may render to the item's manufacturer is a byproduct of their assistance mission and is transmitted to the manufacturer through Army channels. Contract field technicians usually are familiar with a whole end item family and its major components, regardless of the manufacturer; as a result, they are not restricted from working on equipment manufactured by a firm other than their own.

43. Control of Technical Assistance Personnel

a. To properly manage the contract service personnel, the U.S. Army Maintenance Board has been designated as a national control point for supervision of the program worldwide. It serves as a contact point for each technical service and insures that contract service personnel are assigned only to organizations requiring such services. The Board reviews assignments semianually to insure proper utilization of personnel.

b. In addition each technical service is responsible for establishing a control point to monitor its program worldwide and centralize its supervision. Area and local control points may be established by the technical service depots. By such measures as these greater cross utilization of contract skills is achieved between the major command and technical services.

c. Policy and procedures for the control and administration of the Contract Technical Service Program which includes manufacturer's representatives and contract field technicians are contained in AR 750-22.

Section II. MAINTENANCE PUBLICATIONS

44. General

a. Army maintenance management depends primarily on Army regulations for policy guidance in administering the maintenance system. These regulations vary in their scope and detail, ranging from broad directives on echeloning to precise instructions on such matters as how to prepare a field maintenance performance chart. Some major maintenance activities publish their own organization manuals and standing operating procedures (SOP's), while others depend on technical, service-wide organizational directives. The technical levels of the Army maintenance system are also supported by a number of basic publications designed to establish maintenance standards and to assist operating and maintenance personnel in fulfilling their assigned missions.

b. The key publications in this category are the technical manuals which are issued for each type of equipment as well as for general maintenance problems. Maintenance and associated

supply activities are also supported by technical bulletins, supply bulletins and manuals, and miscellaneous informal publications such as maintenance service letters and guides.

45. Technical Manuals

a. The chief of each technical service responsible for developing an item of equipment is also responsible for preparing and issuing technical and supply manuals on the item. These equipment manuals (TM's) are designed to provide operating and maintenance instructions, as well as repair parts and tools data and requisitioning authorization. The pictographic technique, including photographs identifying the item, showing performance of maintenance, and use of "exploded" views of parts involved should be utilized to the maximum extent possible, i.e., a maximum number of pictures and a minimum of words.

b. In the further interests of effectiveness, economy, and echeloning discipline, an Army system for preparation and distribution of

technical manuals has been advised which arranges the manuals in multiple parts according to the respective maintenance echelons.¹ Part I, Operator's Manuals, contains operating and minor maintenance information pertinent to the operator, crew, or user. A list of basic issue items including repair parts, tools, and items carried with the equipment is included as an appendix to the Operator's Manual. Part II, Organizational Maintenance Manuals, contains organizational and preventive maintenance data pertinent to the units and organizations authorized the equipment. They include maintenance allocations charts (MAC's) showing all repair operations authorized to be performed by the various maintenance echelons, plus a repair parts appendix and special tools list for second-echelon maintenance. Parts III and IV are Field Maintenance Manuals, which include technical field maintenance data, lists of parts authorized to maintenance and supply echelons, and guides to parts stockage. Part III includes a list of repair parts authorized for initial stockage for use in third echelon maintenance and supply support to second echelon. Part IV manuals contain a list of repair parts authorized for initial stockage for use in fourth echelon maintenance. Part V, Depot Maintenance and Repair Parts Manuals, contains technical data pertinent to depot maintenance and lists of repair parts authorized for depot maintenance and for initial stockage for maintenance and supply support to lower echelons.

c. Army regulations (AR 310-3) provide for control over publication and distribution of the new multiple part manuals. The chiefs of the technical services may combine parts III, IV, and V in any order they consider feasible. Combinations will be guided by the criterion that excess material will not be given to any manual user. Parts I and II will usually be published separately, but may be combined under the following circumstances:

- (1) If the operator performs the organizational maintenance;
- (2) If first and second echelon maintenance instructions are extremely limited;
- (3) If maintenance is limited to replacement or service instructions;

¹ Army Medical Service items are exempt from this system.

- (4) If only operation or installation, and no maintenance, is required.

Manuals may include appropriate parts from other manuals published on common auxiliary equipment or components.

d. The regulations prohibit combinations other than those listed, but the technical services may submit requests for exceptions to the U.S. Army Maintenance Board.

e. AR 310-3 further dictates that distribution of the parts of the technical manuals will be made strictly according to echelon. Higher echelons are entitled to receive all parts applicable to lower echelons. No provision is made for any exception to this distribution restriction.

f. Technical manuals will continue to be issued on broad and diverse maintenance topics such as the overall maintenance systems used in each technical service, inspection procedures, shop organization, maintenance administrative practices, and organizational equipment pools.

46. Technical Bulletins

Technical bulletins ordinarily are published when technical information must be disseminated to the field prior to its inclusion in technical manuals. Technical bulletins contain technical information pertaining to weapons and equipment or to professional techniques over which the preparing service has responsibility. They do not contain administrative material or material pertaining to technical training or tactical operations. They may supplement equipment technical manuals but they will not make direct changes in the content of the manuals. Instructions published in technical bulletins may be incorporated later in technical manuals. They are numbered the same as the corresponding technical manual with an added serial number if necessary, to identify bulletins on the same equipment.

47. Lubrication Orders

a. Instructions for equipment lubrication are published in the form of lubrication orders. Normally one order is issued for each end item, although some equipment may have several lu-

brication orders when different technical services are responsible for different components. Lubrication orders contain equipment diagrams showing the lubrication points, the type of lubricants required, and the viscosity for various temperatures. Those orders are numbered in the same series as the pertinent technical manual, and a copy of the lubrication order is kept with each piece of equipment in either card or decalcomania form.

b. Lubrication orders are not authorized for equipment that may receive little use, or for equipment requiring only simple and noncritical lubrication. Lubrication instructions for such equipment are contained in the appropriate technical manual. Initial lubrication orders for limited standard or nonstandard equipment may be published only when the equipment is still in use in the field, when such equipment will not be replaced by standard equipment in the near future, and when adequate lubrication instructions are not available.

c. Classified lubrication orders are published only in the pertinent technical manuals bearing the same or higher classification.

48. Supply Manuals and Bulletins

a. Supply publications, like the technical manuals, have been revised. The revised supply manual system is as follows:

- (1) *Type 1—Stock list of all items, except repair parts.* This series will serve as a reference document for depots, supply organizations, and procurement agencies.
- (2) *Type 2—Stock list of all items, price list.* This list will be used by depots, supply organizations, procurement agencies, and troop units.
- (3) *Type 3—Stock list of repair parts.* This list is used as a reference document by depots, supply organizations, and procurement agencies. It should be noted that this is not a stockage guide; that function is served by the technical manual appendixes.
- (4) *Type 4—Stock list of components sets, kits, and outfits.* This series of stock

lists provides information on components of "collection" type items.

- (5) *Type 5—Stock list of current issue items.* This list is not pertinent to maintenance organizations, since it does not include repair parts or special tools.

b. Supply bulletins on logistics administration and procedure are issued periodically. Many contain instructions on storage, packing, marking, and shipping; they are often used by maintenance personnel whose responsibilities encompass associated supply activities.

49. Miscellaneous Publications

a. Equipment manufacturers publish operating and preventive maintenance handbooks which are issued with the equipment. The technical services are required to expedite preparation of operating and maintenance data so that at least parts I, II, and III of the technical manual can be issued simultaneously with the items.

b. Many of the technical services publish informal maintenance service letters to inform using and maintenance units of new maintenance techniques. Such letters advise of field fixes which can be used to correct minor deficiencies without depending on an MWO. Advance information on UER's being reported and on MWO's being developed is issued in informal publications. Maintenance service guides are published by some technical services for use by personnel in the technical assistance program. All of the technical services jointly sponsor PS, an illustrated monthly magazine on preventive maintenance published by the Preventive Maintenance Agency, Raritan Arsenal. This magazine depicts various operating and maintenance problems and offers corrective suggestions. It also lists the latest official maintenance manuals and bulletins issued on various types of equipment.

c. Certain Army theater commands also publish Technical Information Bulletins that disseminate maintenance and related technical information on particular technical service equipments to all users.

Section III. FAILURE REPORTING SYSTEM

50. General

Because of the greater complexity and quantity of new equipment in today's Army, the need for effective failure data reporting is more pressing than ever before. The technical services and the manufacturers responsible for equipment must be kept informed of operating defects so that they can provide troops with reliable, combat-ready items of the most modern design.

51. Unsatisfactory Equipment Reports

a. One of the most vital links between equipment users and the technical services in the failure data reporting structure is the unsatisfactory equipment type of report.

- (1) *DA Form 2028 (Recommended Changes to DA Technical Manuals and Parts Lists (AR 700-38))* is used for the reporting of inaccuracies in maintenance publications.
- (2) *DD Form 1275 (Unsatisfactory Report (UR) (AR 700-41))* is used for Transportation Corps air items only.
- (3) *DA Form 468 (Unsatisfactory Equipment Report (UER))* is used for reporting all other items. (AR's 700-38, 700-1300-8, 700-6500-15.)

b. The unsatisfactory equipment type report is a device common to all of the technical services, used for reporting failures in or related to equipment. The reports extend beyond what their titles suggest. They are also used to report defects in prescribed fuels, lubricants, and preserving materials; to make recommendations for the improvement in design and manufacture of equipment, and recommendations for changes in maintenance instructions, as well as to point up defects in the equipment itself.

c. Prompt submission of UER's to report every defect, failure, and needed improvement in equipment is a direct responsibility of every user of equipment at all levels of command. The reports are submitted for action directly to a National Maintenance Point or other designated agency of the responsible technical serv-

ice. A UER is not submitted when a defect is clearly due to normal equipment wear or tear and accidental damage. Where safety of operating or maintenance personnel is involved, a letter or message may precede the UER.

d. Each UER requires appropriate action by the responsible technical service. Upon receipt of a UER, the National Maintenance Point or equivalent agency assigns it a register number for accounting and followup action purposes. At the NMP, maintenance personnel must evaluate why the item failed and initiate remedial action when appropriate. In carrying out this responsibility, maintenance personnel will draw on the technical resources of research and development, industrial engineering, parts, and packaging activities as necessary.

e. The NMP first determines the priority for handling the UER. Highest priority is assigned to UER's which pertain to the safety of operating or maintenance personnel; second priority is given to items whose operational readiness or susceptibility to serious damage is affected by some deficiency. Routine handling is given to other failures. The NMP then ascertains whether or not the problem reported has been solved. If the problems has been solved, a reply is prepared which indicates the previously recommended or ordered solution. As a rule, if the item is being phased out of the supply system, no action will be taken provided that personnel safety is not involved. Regardless of the priority assigned and action required, each UER is acknowledged upon receipt. Dependent upon the particular problem involved, an interim reply as to its status may be furnished; in all cases, however, the originator of the UER is furnished a final reply indicating the corrective action being taken, or that no action is contemplated.

f. In most cases the evaluation is made on any item of the type reported, but occasionally it is necessary for defective samples to be made available. In this case, the UER originator may be requested to furnish the NMP with a sample, or if the item is too large, a preliminary on-the-spot investigation by field maintenance engineers

may be made and appropriate sketches and photographs forwarded to the action agency.

g. An engineering study may indicate almost immediately that the equipment failure is attributed to normal wear or abnormal use, and that the UER originator simply is not familiar enough with the equipment to know that this was the cause. Further action, therefore, will be unnecessary, and the originator will be informed of this fact. Often the item is found to have failed because of inadequate preventive maintenance or improper application of existing maintenance regulations and procedures. The originator is then advised that the error lies with his personnel rather than with the equipment or the maintenance system.

h. If maintenance doctrine or techniques, or their application, appear to be in error, corrective action should be taken in the form of a maintenance service letter, a revision to the appropriate technical manual, or issuance of a technical bulletin. If the deficiency lies in the design or manufacture of the item itself, the costs of rectifying the trouble must first be estimated to determine whether the correction warrants the time and money to be expended. Actually a number of variations and compromises may be made in deriving a solution to a UER. While it may be prohibitively expensive to make modifications to items already in service, it may be economical with items still in production to issue an Engineering Change Order to cover future production. Similarly it may be decided first to exhaust the faulty components already in the supply system and then issue new and improved parts.

i. The more serious deficiencies reported on equipment may result in the preparation and issuance of modification work orders (MWO's).

52. Failure Reports

a. Another reporting device employed in the maintenance system is the parts failure (or replacement) type report.

- (1) DD Form 787-1 (Electronic Failure Report (EFR), (AR 700-39)). This form is specially designed for electrical accounting machine (EAM) use. EFR's are submitted to report the failure and replacement of parts used

in designated items of electronic equipment.

- (2) DA Form 9-110 (Guided Missile Component Evaluation Data Report), (AR 700-37)). This report is used to report all part failures which occur during the operation and use of guided missile equipment and materiel.

b. The parts failure report is a quantitative type of unsatisfactory equipment report designed to collect and synthesize experience data on all failures of selected items of Army equipment. Failure reports form the basis for statistical analysis of equipment reliability.

c. Failure reports, which are used to report every failure of designated type of equipment, even those apparently due to normal operation, do not require individual action at the NMP as do the UER type reports. Rather, collective data contained in a large number of failure reports form the basis for analyzing deficiencies and effecting necessary changes and improvements in equipment by ECO's and MWO's.

d. An analysis of these reports showing the maintenance most likely to occur should be furnished to pertinent army schools to assist them in teaching diagnosis to repairmen.

53. Modification Work Orders

a. In addition to reducing excessive maintenance, an item may be modified for any one of a variety of reasons, such as to increase the safety of personnel, increase combat or operating effectiveness, facilitate production or rebuild, or eliminate the use of critical materials. As noted above, the NMP is the action agency for processing UER's; this responsibility normally continues through the preparation of the modification work order phase.

b. Maintenance personnel, however, do not function in a vacuum; their coordination with other interested agencies, which is initiated during the UER stage, must be continuous and intensified when preparing modification work orders. Some major modifications may entail changes to established military characteristics of an item. In such cases, a research and development project may have to be instituted and the resulting changes submitted for formal

technical committee action and approval by the General Staff prior to issuance. Even when basic design changes are not involved, it is usually necessary to refer the modification requirement to the industrial division of the responsible technical service or manufacturer. Industrial engineers will be familiar with problems caused by improper production procedures and will be able to offer remedial action.

c. The necessity for modification often arises on an item which is still in production or procurement stages. The modification may involve the fabrication of completely new parts. Under such circumstances, an ECO will precede an MWO as the basis for change. Preparation of the engineer aspects of an MWO, therefore, might be in the hands of the industrial unit rather than maintenance. However, industrial engineers cannot proceed independently. Different techniques may be required to execute an MWO because the capabilities of maintenance echelons may differ appreciably from those available at the factory for carrying out a related ECO. Largely for this reason, final responsibility for preparation of any MWO must rest with the appropriate maintenance division or activity of the technical service.

d. Like an ECO, an MWO must also be coordinated with supply agencies to insure that proper repair parts, tools, and test equipment are in the supply system and available to the maintenance echelon assigned to perform the modification. MWO's should not be issued until such parts, tools, and test equipment are available. Failure to adhere to this simple rule of thumb may mean that extensive preparations will be made to execute an MWO only to find that requisitions for material with which to perform the modification are being levied against nonexistent stocks.

e. MWO's are assigned priority classifications of "urgent" or "normal." The urgent classification requires that modification to all such items in the hands of troops and in the supply system be accomplished at the earliest practicable date. Exemptions may be made on items in long-time storage, but modification of

such items must be accomplished prior to issue. Urgent priorities are usually assigned when combat effectiveness or safety is involved.

f. The normal priority classification calls for modification to be applied as soon as practicable in the field, within the limits of current resources or the time limit prescribed by the head of the developing agency. Accordingly, most MWO's bearing such classifications are accomplished when items come into field maintenance shops or depots for repair or overhaul. Items in storage, especially those already processed and packaged, are not affected unless being readied for issue or when a package is opened for inspection or for any other reason.

g. There are presently no uniform requirements among the technical services for reporting on the status of MWO's. However, the technical services are currently preparing uniform requirements for status reports from the field on selected equipments. Supervision over the execution of MWO's should also be exercised by commanders and through the regular inspection system.

54. The Maintenance Inspection System

a. The maintenance inspection system is an integral part of the maintenance support structure. Closely related to command and command maintenance inspections are staff visits.

b. The chiefs of technical service or their designated representatives may make such staff visits and/or inspections as may be necessary to ascertain the adequacy of maintenance performed on supplies and equipment for which they have been assigned maintenance responsibility. These visits, which are made to all maintenance activities, afford the technical services a direct opportunity to examine maintenance problems in the field and to determine whether the maintenance standards set are being followed, or whether in fact the standards need revision. Staff visits afford the technical services a chance to contact oversea commanders and work out mutual maintenance problems. The control of staff inspections and staff visits is covered by AR 1-200 and chapter 17.

PART TWO

PLANNING, PROGRAMING, BUDGETING, AND FUNDING FOR MAINTENANCE

CHAPTER 5

PLANNING, PROGRAMING, AND BUDGETING

Section I. GENERAL

55. Definitions

An essential element of maintenance management is the process whereby Army maintenance operations are *developed, executed, and controlled*. Fundamental to a discussion of this area is a definition of terms.

a. Plan—A course of action setting forth ultimate objectives. *Planning*—A process for determining objectives and for establishing the basic course of action and requirements for achieving those objectives.

b. Program—A course of administrative action devised for the accomplishment of definitive objectives within a prescribed time period. *Programing*—A process for developing a course of action and a time-phased schedule for accomplishing the objectives of a plan.

c. Budget—An estimate of program costs. *Budgeting*—A process for estimating costs to be incurred in carrying out a program and for executing and reviewing a budget. It formally encompasses budget formulation, execution, and review stages.

d. Financial Management—The management of resources on the basis of their monetary common denominator through effective funding and control systems at various levels of command.

e. Financial Management Plan—A collection of various financial control methods by which the Army manages its funds.

f. Army Command Management System—The methodology for directly and continuously

relating program, budget, accounting, manpower and supply management systems in administering nontactical operations of the Army.

56. Planning, Programing, and Budgeting Process

a. The total process by which operations are translated from national security objectives into operating programs can be divided into six stages: (1) determination of national security objectives, (2) planning; (3) programing; (4) budget formulation; (5) budget (and program) execution; and (6) budget (and program) review.

b. The first four stages precede the fiscal year; the preparation process begins 6 months prior to the fiscal year and continues for 18 months; the review stage formally involves performance review during the fiscal year. Since the budget is essentially a pricing of programs, the execution and review of the budget encompasses the programs throughout most of the cycle. The various financial and command management controls provide a tool both for administration of programs and formulating programs and budgets for ensuing fiscal years. Economy has not replaced military effectiveness as the prime national security objective, but in a period of rising weapons systems costs, of global obligations, and of limited budgets, economy necessarily plays an important role. The economical use of resources is a command responsibility and extends throughout all levels of the maintenance organization.

57. Maintenance Plans, Programs and Budgets, and the Logistics System

a. Effective planning, programing, and budgeting for future operations, coupled with sound program controls, greatly affect the ability of the Army to carry out its maintenance objectives. Army maintenance programs and budgets must be developed in a manner which will insure that resources are efficiently allocated and that maintenance is properly related to the total Army logistics system. It is important that technical assistance be programed in accordance with Army policy and that provisioning programs be economically implemented. It is particularly essential that depot overhaul programs be coordinated to provide for equitable distribution of workloads within the CONUS depot system and similarly that oversea overhaul programs be related to CONUS programs.

b. Relating maintenance to the total logistics system is essential. Product improvement programs must be prepared, funded, and executed in concert with projected research and development efforts. Formulation of overhaul programs must be coordinated with new procurement in order to provide for modernization of the Army at the most economical rate.

c. The common objective of procurement and overhaul is a requisite to economical supply management. Overhaul must be programed with discrimination. If an item is scheduled for replacement by a new design, continued overhaul of such equipment may lead to unnecessary expenditures of resources. New procurement of identical model types may be more economical than repeated overhauls. Excessive reliance on overhaul as a source of supply defers procurement of new, more efficient equipments.

d. Maintenance planning, programing, and budgeting at every echelon must be undertaken with full regard to the relation of each plan, program, and budget to others within maintenance and the total logistics system. They must be carried out pursuant to basic Army policies, objectives, and missions.

58. Mobilization Plans

a. Planning for mobilization, which has long been a fundamental axiom of national strategy,

has assumed a preeminent position since World War II. Military planning is necessitated by the need for anticipating enemy capabilities and maintaining, in being, a force sufficient to deter or defeat enemy aggression. Planning is also necessitated by the long lead times inherent in developing modern weapons and supporting systems.

b. The Army's mobilization plans directly affect Army maintenance. The force levels established dictate support requirements. The deployment of forces determines environmental maintenance conditions as well as repair parts supply factors. Estimates of enemy capabilities and probable courses of action affect equipment types and quantities and the maintenance required to support these equipments. A basic familiarity with Army planning, especially in logistics areas, is important to a better understanding of Army maintenance.

c. The Army staff prepares a balanced 5-year program stated in terms of forces, facilities, and material required to implement the Army midrange plans. There are five Control Programs, namely, Troop, Installation, Material, Reserve Components, and Research and Development. They cover a 5-year period roughly corresponding to the midrange planning period: the base year (FY X-2) the succeeding execution year (FY X-1) the target or budget year (FY X) and two additional fiscal years (FY X+1 and X+2). The Control Programs are revised and issued annually; the FY-X programs, for example, are issued in February of FY X-1. The programs provide the link between the midrange plans and the target year budget.

d. Continuing with the description of the basic cycle for FY X (fig. 5), in the period FY X-2 the Department of the Army issues separate Program and Budget Guidance documents to each command and agency, including DCSLOG, USCONARC, and oversea commands. The preliminary guidance leads to the preparation of command budget summaries and a consolidated Army Budget Estimate by the end of FY X-1. In January of FY X-1, after the Army budget has been reviewed by the Department of Defense (DoD) and the Bureau of the Budget (BOB), the President submits it to the Con-

BASIC ARMY PLANNING, PROGRAMMING AND BUDGETING CYCLE

FY X-6, X-5, X-4	FY X-3	FY X-2	FY X-1	FY X	FY X+1	FY X+2	FY X+3	FY X+4
1 J U L	1 J U L	1 J A N	1 J U L	1 J U L	1 J U L	1 J U L	1 J U L	1 J U L
36 MOS	12 MOS	6 MOS	18 MOS	12 MOS	12 MOS	36 MOS	THREE-YEAR WAR ASSUMED FOR ASOP PLANNING PURPOSES	
ARMY REQUIREMENTS DEVELOPMENT PLAN AND JOINT LONG-RANGE STRATEGIC ESTIMATE PREPARED DURING FY X -6	ARMY MID-RANGE ESTIMATE PREPARED AUG - OCT JOINT STRATEGIC OBJECTIVES PLAN (JSOP) ISSUED MAY	ARMY STRATEGIC OBJECTIVES PLAN (ASOP) ISSUED JUL MOBILIZATION REQUIREMENTS IN SUPPORT OF THE ARMY STRATEGIC OBJECTIVES PLAN (MOB-R-ASOP) ISSUED OCT	CONTROL PROGRAMS PREPARED FEB ARMY BUDGET ESTIMATE PREPARED AUG PRESIDENT'S BUDGET SENT TO CONGRESS JAN OPERATING PROGRAMS & BUDGETS PREPARED MAR - MAY APPROPRIATIONS REQUESTS REVIEWED MAY-JUN APPORTIONMENT JUN	FY X FUNDS AVAILABLE FOR EXPENDITURE MODERNIZATION AND BUILDUP TO MEET M-DAY REQUIREMENTS FOR VARIOUS TYPES OF WAR				

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Figure 5. Basic Army planning, programming and budgeting cycle.

gress. The presentation of the Army's budget is followed by each command's preparation of Operating Programs, each of which includes an Operating Budget and is compiled in consonance with the Control Programs. These Operating Programs are based on revised Program and Budget Guidance. Congress, meanwhile, holds hearings on the Army budget, and the Department of Defense and Bureau of the Budget re-

views the Army's request for the apportionments which follow passage of an Appropriation Act. On or about the end of FY X-1 Congress passes the Appropriation Act and money is available to the Army for obligation during FY-X, subject to BOB apportionment via DoD. A final revision of the Operating Program is made by the Army commanders upon receipt of the final approved program and budget.

Section II. PROGRAMING

59. General

a. The Army has in being a formal Army Program System to implement the National Security Act Amendments of 1949, which called for greater emphasis by the military departments on financial management and adoption of performance (or functional) budgets.

b. The Army Program System, as contained in AR 11-1, provides a method for the organized direction and control of the peacetime military activities of the Army. The system relates budgeting to programing. The current year Program System goes into effect upon approval of the Army Strategic Objectives Plan (ASOP). The Program and Budget Advisory Committee, which is composed of representatives from the Department of the Army staff, meets in January of FY X-2 and prepares Control Program objectives and Summary Budgets, which provide an initial basis for more detailed program and budget development. These documents not only present basic objectives and policies for preparing the Control Programs, but they also give broad maximum budgetary figures for each major mission area, such as Operation and Maintenance. By 15 January, the Secretary of the Army and the Chief of Staff ordinarily will have reviewed, amended as appropriate, and approved the Control Programs Objective and Summary Budget. After Secretary of the Army and Chief of Staff approval, the Program and Budget Advisory Committee issues a Control Program Directive, normally by 31 January, which serves as the guide for preparation and issuance of the Control Programs. This guidance document includes the basic military and political assumptions, force levels and structure, general priorities, types of equipment, and training program for each requirement.

60. Control Programs

a. The core of the Army Program System lies in the five Control Programs (Troop, Installations, Materiel, Reserve Components, and Research and Development) which provide guidance and objectives for developing the annual performance budget for the Department of the Army. The assignment of Army staff responsibilities is as follows:

<i>Control program</i>	<i>Primary Department of the Army staff responsibility</i>
Troop-----	Deputy Chief of Staff for Personnel
Installations-----	Deputy Chief of Staff for Logistics
Materiel-----	Deputy Chief of Staff for Logistics
Reserve Com- ponents.	Assistant Chief of Staff for Reserve Components.
Research and Development.	Chief of Research and Development

b. The maintenance system is affected in various degrees by all of the programs. The strength and structure objectives for the Active Army set forth in the troop programs establish the troop base requiring maintenance support. Similarly, the Research and Development Program provides for the level of R&D effort over the programmed period and this effort, in turn, requires concurrent maintenance planning on new equipments being developed. The primary program affecting maintenance, however, is the Materiel Program which guides materiel programing throughout the Department of the Army for a 5-year period, of which the middle year is the target fiscal year.

c. *The Materiel Program.*

- (1) Establishes objectives and guidance for the procurement, production, storage, maintenance, utilization, modernization, and disposal of Army supplies and equipment (personal property) in support of peacetime and mobilization requirements.

- (2) Establishes quantitative requirements for materiel in support of Army plans, as well as phased objectives and guidance for the acquisition and delivery of end items to fill estimated deficiencies.
- (3) Establishes criteria and objectives governing the attainment and maintenance of an optimum balance between end-item stocks and the production capability of the industrial base.
- (4) Sets forth specific guidance for the modernization of Army materiel in terms of time-phasing of new items entering and obsolete items to be withdrawn from the Army supply system.
- (5) Sets forth standards and criteria for repair parts supply and the maintenance and rebuild of Army materiel to insure maximum economy in materiel management and conformity with materiel modernization objectives.

d. The basic document for the Materiel Program generally comprises eight sections—

- I. General
- II. Materiel Requirements
- III. Modernization of Materiel
- IV. Procurement
- V. Production
- VI. Maintenance of Materiel
- VII. Storage and Distribution
- VIII. Disposal of Materiel.

e. Supporting the basic documents are nine annexes, as follows:

- I. Materiel Planning Studies
- II. Army Materiel Control Program
- III. Procurement of Equipment and Missiles
- IV. Central Supply Activities
- V. Materiel Maintenance
- VI. Army Stock Fund Program
- VII. Materiel Program Analysis
- VIII. Communications
- IX. Medical Materiel.

f. The Maintenance of Materiel section of the basic document prescribes objectives and policies in the areas of technical doctrine, publications, repair parts, organizational maintenance, field maintenance, depot maintenance, and technical assistance. As a policy guide to the tech-

nical services and Army commands, the Materiel Program is explicit in a number of areas, both in emphasizing and clarifying existing Army regulations and in setting new policies, i.e., a current Materiel Program—

- (1) calls for an Inspect and Repair Only as Necessary (IROAN) policy;
- (2) urges an extension of periodic maintenance intervals when possible;
- (3) emphasizes maintenance support planning and the maintenance package;
- (4) reemphasizes the practice of controlled cannibalization;
- (5) stresses the importance of concurrent delivery of end items and technical manuals; and
- (6) directs that the contract technician program not be misused.

61. Program and Budget Guidance

a. The development of Operating Programs by each Army command, agency, and installation in consonance with the five Control Programs is initiated by a document known as Program and Budget Guidance. This document is issued by the DA staff three times prior to the beginning of each target fiscal year in preliminary, revised, and final form in May, February, and June respectively. The Preliminary Program and Budget Guidance provides USCONARC and oversea commands a basis for preparing the Commander's Statement and Budget Summary. The Revised Program and Budget Guidance forms the basis upon which commands and agencies reporting direct to and funded by the Department of the Army may prepare Operating Programs. The Final Program and Budget Guidance reflects apportionment of funds and is used to adjust Operating Programs.

b. The incorporation of budget as well as program guidance within these documents and the inclusion therein of Operating Budgets (formerly Budget Execution Plans) demonstrates the meshing of the programing and budgeting processes that occurs during the last 14 months preceding the target fiscal year. Since what is being developed is, in essence, a program budget, the programs and budgets are completed simultaneously and take much of their direction from the same guidance documents. In order to

distinguish the two processes as they develop, one may view the budget formulation process in terms of the development of the Army Budget for submission to DoD, BOB, the President, and Congress. The budget execution process may be viewed in terms of methods applied in funding the Operating Program.

c. Program and Budget Guidance is issued by the Chief of Staff to USCONARC, oversea commands, to DCSLOG who directs and controls the technical services, other DA operative agencies, and to the technical services by DCSLOG in five sections as follows:

Section I. Missions—of each addressee

II. Control Guidance

Part A. Troop Basis — including strength and location of units; activations, inactivations, or redeployment; estimated military and civilian personnel to be authorized.

Part B. Installations — including activations, inactivations, and changes in status.

Section III. Guidance by Budget Classification

IV. Support Services Guidance

Part A. General

B. Local Headquarters Command Administration

C. Local Welfare Services

D. Local Maintenance and Management of Facilities

E. Field Maintenance

Section V. Administrative Instructions

d. Guidance in Section III is presented by appropriate title in accordance with the Army budget structure. For the Operation and Maintenance, Army (O&M,A) appropriation, the title is further broken down by budget program. This breakdown, with assigned DA staff responsibility, is contained in figure 6. Note that in the actual Program and Budget Guidance the Major Overhaul and Maintenance of Materiel (BP 2300) program is not further segregated by project, such as Overhaul Activities. The segregation as shown in figure 6 is only for purposes of illustrating in more detail the budget program as it relates to maintenance.

e. The guidance contained in Section III under Major Overhaul and Maintenance of Materiel (Budget Program 2300) is primarily di-

rected toward depot maintenance and is expressed in terms of a funded cost target for overhaul, including estimates for reimbursable costs and for operation and maintenance policies, priorities, and standards, and major workload objectives. Budget guidance for field maintenance is given in Section IV with a funding estimate shown for 9040 Secondary Expense Account monies which themselves are funded out of major activities called carrier accounts.

62. Commander's Statement and Budget Summary

The Preliminary Program and Budget Guidance provides the basis for a commander to prepare a Commander's Statement and Budget Summary. The USCONARC summary is a consolidation of summaries prepared by the ZI armies and the Military District of Washington. This document, which is submitted to the DA Staff in July of FY X-1, includes the commander's appraisal of the effects of the funding limitations and program guides contained in the Preliminary Program and Budget Guidance on the commander's mission for the operating target year, and a forecast of program operations. In the case of oversea commands that are operating maintenance shops, the summary includes a statement of overhaul requirements.

63. Operating Programs

a. Each command, agency and installation in the Army Establishment annually prepares Operating Programs covering the peacetime operations for which it receives funds. These Operating Programs combine in one document the funding estimates, objectives, schedules, and operating budgets. The programs are prepared at installation level and submitted through the next higher headquarters, where they are consolidated. DCSLOG provides guidance to the technical services to aid in their preparation of depot maintenance operating programs.

b. The purposes of Operating Programs are essentially as follows:

- (1) To integrate programing and budgeting.
- (2) To provide for a central recording of programs to be conducted during the target fiscal year and a recording of the resources (personnel, funds, ma-

PROGRAM AND BUDGET GUIDANCE (O & M, A)

PROGRAM AND BUDGET STRUCTURE

DA STAFF RESPONSIBILITY

OPERATION AND MAINTENANCE ARMY

COMPTROLLER OF THE ARMY (ASSOCIATES LISTED BELOW)

2000	OPERATING FORCES	DCSOPS
2100	TRAINING ACTIVITIES	DCSOPS
2200	CENTRAL SUPPLY ACTIVITIES	DCSLOG
2300	MAJOR OVERHAUL AND MAINTENANCE OF MATERIEL *	DCSLOG
2310	MAJOR OVERHAUL ACTIVITIES	DCSLOG
2320	MODIFICATION ACTIVITIES	DCSLOG
2330	RENOVATION OF AMMUNITION, AND SPECIAL WEAPONS ACTIVITIES	DCSLOG
2340	MAINTENANCE ASSISTANCE AND ENGINEERING SERVICES	DCSLOG
2350	RELATED MAINTENANCE ACTIVITIES	DCSLOG
2360	PROCUREMENT OF PARTS AND KITS (NON-STOCK FUNDED)	DCSLOG
2370	PROCUREMENT AND PRODUCTION OF CAPITAL EQUIPMENT	DCSLOG
2400	MEDICAL ACTIVITIES	DCSLOG
2500	ARMY-WIDE ACTIVITIES	DCSPER
2600	ARMY RESERVE AND ROTC	ACSRC & CARROTC
2700	JOINT PROJECTS	COA
2800	INTELLIGENCE ACTIVITIES	ACSI
2900	ARMY-WIDE COMMUNICATIONS AND PICTORIAL SERVICES	DCSLOG

* BP 2300 IS NOT ACTUALLY BROKEN OUT IN PROGRAM AND BUDGET GUIDANCE

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Figure 6. Program and budget guidance (O&M, A).

teriel, and facilities) to be allocated in support of the reporting commander's mission.

- (3) To identify the programs to be accomplished by subordinate commands, agencies, or installations.
- (4) To establish a programed benchmark against which operations in a given year can be measured.

c. Operating Programs follow the Army Management Structure in a manner closely paralleling that of the Program and Budget Guidance document. There are two parts to an Operating Program: a Basic Document; and Schedules.

- (1) *Basic Document*. The Basic Document consists of six sections:

- I. Missions

- II. Controls—unit deployments and authorized strengths for military and civilian personnel, and installations status.

- III. Operating Program Budget Classification—estimated dollar resource authorization for each major activity or budget project as applicable; objectives, policies, and priorities for each activity for which guidance is required.

- IV. Support Services—objectives, policies, and priorities for installation support (Operation and Maintenance of Facilities activity).

V. Administrative Instructions — guidance on submission of Operating Programs, progress reports and statements of analysis.

VI. Operating Budget—prepared by each command, agency, or installation as a detailed resources plan setting forth the funds required to implement the Operating Program. It provides to subordinate commanders the means of expressing to higher echelons of command how and where funds will be utilized. In addition, it shows the time-phasing for such utilization. The Department of the Army, in turn, uses the Operating Budget as a basis for requesting apportionment of funds from DoD and BOB, and subsequently for establishing or revising funding programs.

- (2) *Schedules*. Operating Program schedules consist of Directed Schedules and Operating Schedules.

- (a) Directed Schedules show quantitatively by time-phasing (usually by quarters) how the specific annual objective as designated by the next higher command will be accomplished.

- (b) Operating Schedules indicate individually by subordinate elements when, by time-phasing, they will accomplish their objectives.

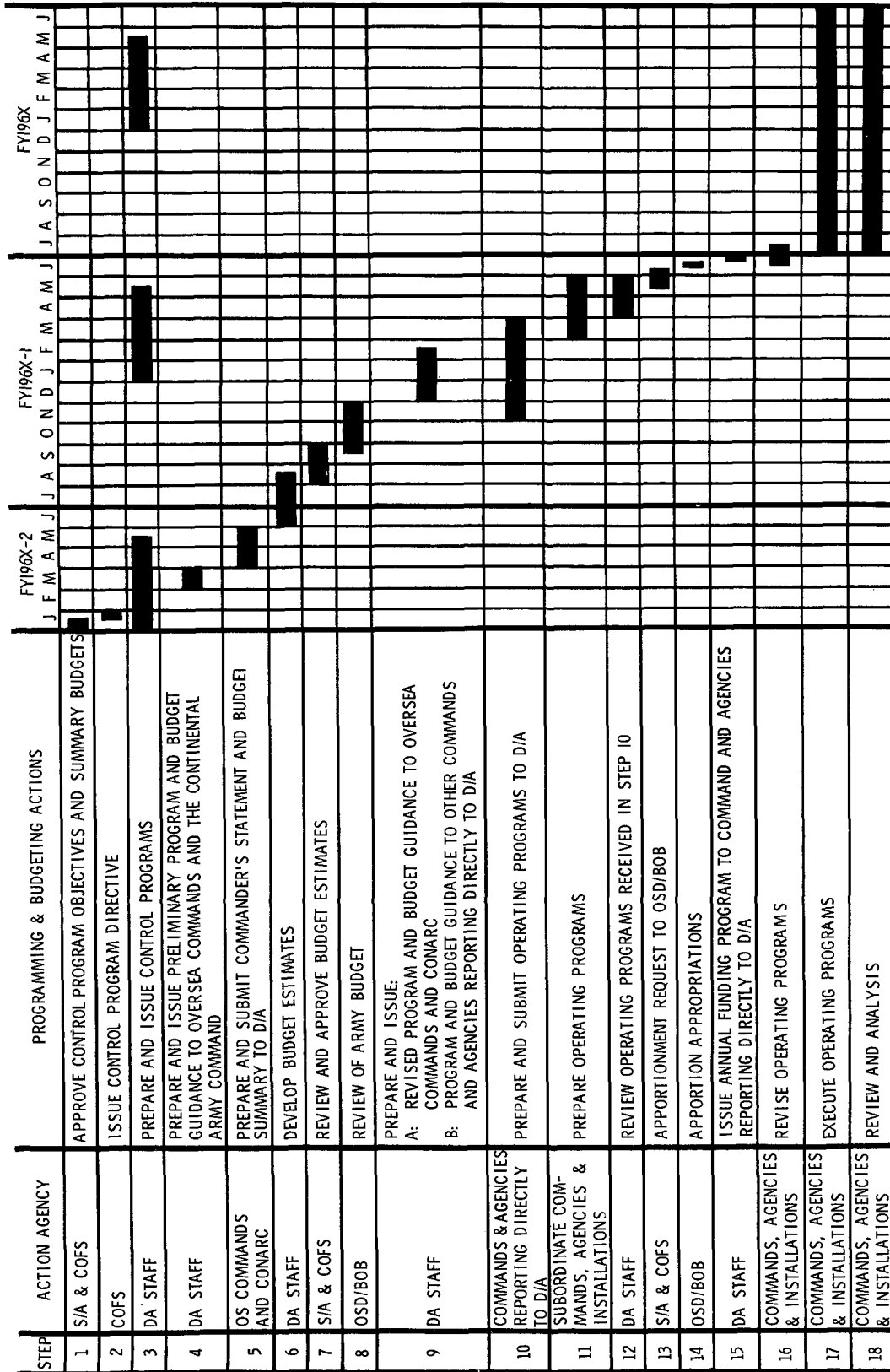
Section III. BUDGETING AND FUNDING: A SYNOPSIS

64. Budget Formulation

a. The budget formulation process (fig. 7) commences approximately 18 months prior to the target fiscal year with the issuance by the Secretary of Defense of budget planning assumptions and guidelines to the Secretary of the Army. Further guidance for budgeting is afforded by development at the DA Staff level of the control programs and the Preliminary Program and Budget Guidance. Upon completion of these programming documents, the Comptroller issues in about mid-May (13 months prior to FY-X) the Budget Formulation Directive for Military Functions Appropriations. This directive calls for preparation of a staff-developed budget by the Army staff under the overall direction of the Comptroller of the Army, who serves as Director of the Army

Budget. USCONARC and oversea commands are informed of the funds which may be made available to them through the media of their respective Revised Program and Budget Guidance. The budget program directors on the DA Staff then prepare the Army-wide budget estimate for each appropriation and program. DA staff responsibility for developing the Major Overhaul and Maintenance of Materiel Program (BP 2300) rests with the Materiel Maintenance Division of DCSLOG. Field maintenance budgeting at DA staff level for the technical service-controlled class II installations is also accomplished by the Materiel Maintenance Division, but for apportionment and appropriation purposes the Comptroller allocates the field maintenance technical service accounts to the various major budget program activities in-

ARMY PROGRAM / BUDGET CYCLE



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Figure 7. Army program/budget cycle.

cluding BP 2300. For the ZI field armies and class I installations, as well as for oversea commands, the field maintenance budget is made up by DCSOPS in conjunction with DCSLOG. In CONUS, USCONARC consolidates the ZI army and MDW operating programs and budgets and provides appropriate guidance.

b. The Office of the Comptroller of the Army (COA) gives each element of the Army budget estimate a complete review. A final review is made by the Budget Advisory Committee (BAC). The BAC is composed of permanent voting members representing the Comptroller of the Army, the Deputy Chief of Staff for Personnel, the Deputy Chief of Staff for Logistics, the Chief of Research and Development, the Assistant Chief of Staff for Intelligence, and the Deputy Chief of Staff for Military Operations.

c. Upon completing its review in early fall of FY X-1, the BAC then forwards the budget estimate for approval through the Chief of Staff, the Secretary of the Army, and the Secretary of Defense to the Bureau of the Budget. Further review is conducted at DoD and BOB levels. The Army's budget estimate is then incorporated into the President's Budget for presentation by the President in his annual budget message to the Congress in mid-January.

d. The President's Budget is returned to the Committees on Appropriations of the Senate and House of Representatives. The House Subcommittee on Department of Defense Appropriations holds the initial series of hearings, at which appropriate DA Budget Program Directors explain and defend the Army budget position on the various DA appropriations. Army presentations at both House and Senate hearings are coordinated by the Director of Army Budget, COA, and the budget programs directors. After the House debates and passes the House defense bill, the Senate Subcommittee on Department of Defense Appropriations holds hearings. The Senate bill, if necessary, is reconciled by a joint House-Senate conference and a Conference Report goes to the House and Senate which, in turn, pass what is called an enrolled bill, which is received and approved by the President and incorporated into the Appropriations Act for the target fiscal year.

65. Budget Execution

a. The Army Budget Execution Process encompasses the development and control of detailed fund requirements for the conduct of operations by Army commands, agencies, and installations. It specifically involves obtaining obligational authority from DoD and BOB; distributing or allocating funds; and applying fiscal controls to insure accomplishment of DA objectives set forth in approved operating programs. Budget execution begins 6 months prior to the target fiscal year with the submission of the President's budget message to the Congress, thus overlapping the formulation process, and it continues through the target fiscal year.

b. After presentation of the Army budget to Congress, the five Control Programs are changed to reflect the current status of Army appropriations. Based on these changes, Program and Budget Guidance is revised by the DA Staff and issued about mid-February to the general and special operating agencies that report to end are directly funded by Department of the Army. Operating Budgets in support of the Operating Programs are prepared and submitted through command channels to the DA Staff. In early May the Budget Program Directors, in conjunction with the Director of the Army Budget prepares apportionment requests and submits them through DoD to BOB for obligational authority. An apportionment is an authorization by the Director of the Budget to a government agency making available for obligation a designated portion of an appropriation, contract authorization, other statutory authorization, or a combination thereof.

c. The apportionment requests are subject to review by OSD and BOB; final approval is given by BOB. The apportionments are transmitted via DoD to DA; the Director of the Army Budget, COA, then marks up the Operating Programs and prepares an Annual Funding Program based on recommendations of Budget Program Directors. The Budget Advisory Committee again meets in early June to review and approve both the Annual Funding and Operating Programs. The Control Programs are subsequently modified in accordance with the Annual Funding Program and Final Program and

Budget Guidance is issued by the Chief of Staff. The Operating Programs are then revised to reflect this guidance and returned to subordinate commands.

d. At the beginning of the fiscal year the operating agencies distribute funds through allocations and allotments to agencies, installa-

tions, or activities. During the fiscal year the budget at various operating levels is exposed to continuous review, analysis, and adjustment. Emphasis is placed on submitting quarterly reports to higher authority, since allocations and allotments are generally made on a quarterly basis.

Section IV. PROGRAMING AND BUDGETING FOR DEPOT MAINTENANCE

66. Bases for Developing Army-Wide Overhaul Programs

a. The preceding discussion of the planning, programing, and budgeting cycle has outlined the total process in general terms, with emphasis on the maintenance aspects. This section will focus more specifically on depot maintenance, chiefly major overhaul of materiel. A distinction will be made, as necessary, between CONUS depot overhaul, which is primarily a technical service responsibility, and oversea depot overhaul, which is basically a command responsibility.

b. The overhaul programs have their bases in the current Materiel Program for which the Requirements Division of ODCLOG, assisted by the technical services, computes requirements for principal items. These computations are the prime factor in technical service computation of major and minor secondary items as well as repair parts.

c. Field manual 38-1 discusses requirements planning in considerable detail. In brief, the requirements process, with particular reference to overhaul, operates in the following manner:

- (1) In consonance with the ASOP, the Army Materiel Control Program is developed to reflect the major items required to be in inventory to meet total requirements of the inventory objective.
- (2) The requirements are basically computed by applying TOE (Table of Organization and Equipment) and TA (Table of Allowance) factors to the projected force levels. In addition, requirements computations consider—
 - (a) losses due to training or other attritions;

- (b) combat losses;
- (c) stockage levels and intransit materiel;
- (d) Class IV Project requirements which are not generally reflected in TOE's and TA's.

d. Current serviceable assets are computed periodically by the various National Inventory Control Points (NICPs) for their respective commodities based on stock status reports submitted by depots and field commanders. By applying projected losses, this figure can be used in estimating available assets for any target year materiel program. The next step is to determine whether remaining requirements are to be met by new procurement or overhaul. In both cases, new procurement or overhaul may be made either to—

- (1) augment inventories in order to meet increased force materiel requirements; or
- (2) replace items which are expended, lost in training, or which have become unserviceable.

e. Overhaul is used only to restore economically reparable unserviceables to a serviceable asset state. New procurement is employed to—

- (1) introduce totally new families of equipments improved in concept and capability;
- (2) replace existing obsolescent items with improved models; or
- (3) replace with equivalent or only moderately improved new items certain types of unserviceables that cannot be economically repaired.

f. The modernization program as it pertains to phasing out obsolescent items with new models has a distinct impact on maintenance.

Any advance programing or overhaul must carefully consider the phasing-in of new items in order to preclude any costly overhaul or modification of an item soon to be disposed of. The preparation by the technical service of "no rebuild lists" correlated with new procurement is designed to insure the orderly phase-in of new items. Where new procurement versus overhaul involves not only combat effectiveness but economy, the programing for overhaul is guided by the economic repair limit policies laid down by the cognizant technical service.

g. Development of sound overhaul programs by the technical services and oversea commands depends largely on the effective correlation of economic repair policies with inventory control management. The basic tools for developing annual programs are the Material Planning Study (DD Form 764) for principal and major secondary items and Supply Control Study Minor Secondary Items and Repair Parts (DA Form 1794) for minor secondary items. These studies are prepared periodically on a worldwide inventory basis by the NICPs, under supervision of the cognizant technical service, and indicate repair requirements whenever total requirements for an item exceeds the total quantity of serviceable assets plus items due in from previously scheduled repair or procurement. By applying an average cost-of-rebuild figure, derived from historical cost and cost trends, a total cost of depot overhaul for a given line item or generic category can be reached. These costs can then be used in compiling the depot maintenance budgets in support of the programs.

h. The allocation of specific work orders among the individual depot shops is essentially one of scheduling. Nevertheless, in order to insure stability of operations among depots, a basic allocation of anticipated overhaul workload and necessary funds must be made by each technical service when preparing the depot maintenance programs and budgets for each fiscal year. The factors to be considered include the special capabilities of each depot, the relative operating efficiencies, the location of major stocks of economically reparable assets, the location of major customers, the workload necessary to sustain each depot's current work force and facilities,

mobilization requirements, and long-range strategic operating requirements. All factors must be weighed; therefore cost is not necessarily the dominant element. Each technical service knows well in advance of a target fiscal year the approximate size of the BP 2300 budget and the major overhaul requirements. It must then be decided whether to operate on this budget with the current number of shops, existing staffing patterns, and workload levels, or whether a change in the overall depot structure is desirable. The Department of the Army and the technical service may decide independently of a given year's budget to close a depot for reasons of inherent inefficiency, obsolescence, or change in total Army planning needs. In other instances, one or more low budget years for depot maintenance may force the decision to close certain depot shops or reduce their operation to standby status. Once the basic Army depot maintenance system is firmly established for the year, the total program and budget can be initially prepared for each depot.

67. Programing and Budgeting at CONUS Depots

a. The development of individual depot maintenance programs and budgets in support of the annual Department of the Army Materiel Program serves several purposes. They provide a basis for the Department of the Army, the technical services, and the depots to program prior to the target fiscal year the depot maintenance workloads to be accomplished and the funds which will be required. In analyzing the programing and budgeting process, it is difficult to conceive of the process as a rigid chronology in which guidance and data flow in a definite pattern. As with Army-wide logistics planning, programing, and budgeting, the depot process is one in which there is a flow of policy directives, objectives, requirements, and capabilities vertically and laterally throughout the logistics chain of command. The goals are simple, namely, to decide what un-serviceable assets should be overhauled, where and when they should be overhauled, and how much money should be expended. The means of setting out these goals with definitive depot maintenance programs and budgets are complex.

b. All of the technical services conduct their programing and budgeting for depot maintenance in according with Department of the Army Planning and Programing Manual (FM 101-51); the Army Command Management System (AR 11-45); and the Army Budget System (AR 37-1). Within this broad policy framework, each technical service employs individual procedures, reporting forms, communication methods, and timetables. There are variations in the respective roles played by technical service headquarters, national maintenance points, and national inventory control points due to the differences inherent in each technical service's overall organization for supply and maintenance. Other variations can be found in the degree of detail with which different technical services prepare headquarters or NMP program and budget guidance for transmittal to the depots.

c. The Department of the Army has integrated programing, budgeting, and funding under a single account structure in line with the Army Command Management System. Similarly, as at higher levels, depot maintenance programing and budgeting have been carried out as coordinate actions both in their formulation and execution stages. Most depots have a Program-Budget Advisory Committee; the Program Directors and Comptroller and their staffs also work closely in developing coordinated Operating Programs and Operating Budgets particularly during the 6 months preceding the target year.

d. Although programs and budgets during the latter stages of the budget execution process generally can be closely coordinated, it is difficult during the budget formulation process (January to January prior to the target fiscal year) to achieve this coordination. The lengthy process of compilation, review, and approval required to develop the federal budget has necessitated computation of total dollar figures for the O&M,A appropriation about 12 to 18 months prior to the target fiscal year. Theoretically, the initial budget estimates for maintenance reflect the projected depot operating programs. Practically, this cannot be accomplished because computation and correlation of serviceable assets, unserviceable assets, operational needs, overhaul capabilities,

and overhaul requirements necessary to pricing out a detailed program are exceedingly difficult to achieve earlier than 6 months prior to a fiscal year. The apparent inability to delay initial budget preparation until operating program development, or conversely, to accelerate programing has resulted in the submission of installation depot (and field) maintenance programs and budgets after the Army commands and Department of the Army staff agencies and technical services have prepared their consolidated operating programs and budgets, and after the total Army budget has been submitted to Congress in January preceding the target fiscal year. This so-called "telescoping" procedure is not compatible with the concept of a requirements defense budget generated by consolidating budget programs as they proceed up the chain of command. To a great extent it supports the concept of a ceiling budget which starts at Department of Defense levels and works its way down the chain of command, where at some later time in the budget cycle it must be reconciled, usually to its advantage, with the requirements budgets being compiled by lower echelons.

e. All of the technical services are faced to varying degrees with the telescoping problem on depot programing and budgeting. Most depots commence rough estimate programing on maintenance early in the program-budget cycle—in some cases, as much as 10 to 12 months prior to the fiscal year. These efforts have taken the form of early consideration by technical services, NMP's, and NICP's of the Materiel Planning Studies with specific reference to correlating reparable assets with overhaul capabilities and with requirements.

- (1) In some technical services, a tentative depot maintenance program is developed by the National Inventory Control Points in September (FY X-10 months). This program, costed out, would indicate by commodity classification the overhaul and modification activities to be conducted at the various CONUS depot maintenance shops. In early November (FY X-8 months), the revised, but still tentative, depot maintenance program is sent to the depots. The depot "marks up" this tentative program and programs the

annual projected workload to reflect by quarter, the number of items and cost of overhaul within each commodity class scheduled for completion. These marked-up depot maintenance programs are consolidated by the technical service's designated control point (usually an NMP or NICP) and necessary adjustments are made to balance out workloads and funds throughout the depot system.

- (2) After the President's Budget Message has been delivered to the Congress in early January (FY X-6 months), depot maintenance programing budgeting can become more finite. In mid-February, the technical services receive Program and Budget Guidance and the DCSLOG Operating Program from the Deputy Chief of Staff for Logistics. The receipt of these documents formally sets in motion the budget execution process for depot maintenance. During the spring, the technical services continue to make CONUS-wide program adjustments. The approved operating programs for each depot are usually received in June.
- (3) Approved depot operating programs require close analysis by depot maintenance divisions to determine whether the programed workloads can be accomplished within the approved depot program budget. If not, the BP 2300 Program Director must determine whether workload priorities should be revised and whether resources should be transferred among projects within BP 2300. Depots may not transfer funds from BP 2200 or 2400 to BP 2300 in order to strengthen the depot maintenance program; adjustments (subject to DA policies and criteria) may be made at depot levels only within each budget program.

- (4) After final adjustments are made in June, the depot maintenance divisions formally shift from programing to scheduling.

68. Programing and Budgeting for Oversea Depot Maintenance

a. The programing and budgeting process for overseas Major Overhaul and Maintenance of Materiel (BP 2300) is essentially the same as that followed by CONUS depots. The overseas depots are commanded by major overseas commanders rather than by the chiefs of the technical services. The technical services, however, have been designated by DCSLOG to exercise primary worldwide materiel control. Since overseas overhaul programs must be compatible with worldwide materiel control, the technical services play an important role in overseas programing and budgeting for overhaul. Acting through their NICP's, they inform overseas commanders of materiel requirements. These data provide a basis for overseas commanders to compute overhaul needs. The technical services review overseas programs and budgets and make programing and budgeting recommendations to DCSLOG. They keep overseas commanders advised during the program and budget cycle as to changes in worldwide overhaul requirements, changes in status and standards of materiel, and the availability of newly adopted replacement items. In addition, the technical services provide technical data for overhaul, serviceability standards, and maximum overhaul and repair cost limitations. DCSLOG is assisted by the chief of the technical services in reviewing and adjusting overseas programs, but it retains direct responsibility for issuing formal guidance and directives on depot maintenance to the overseas commanders.

b. The general policies and the cycle for overseas depot overhaul programing and budgeting are described in detail in AR 750-4.

Section V. PROGRAMING AND BUDGETING FOR FIELD MAINTENANCE

69. General

a. The basic principles and cycle of the Army programing and budgeting system apply to field

as well as depot maintenance. One major distinction is that telescoping of programing and budgeting for field maintenance is even

more pronounced than it is for depot maintenance; at installation level most of it is accomplished in the last quarter of the fiscal year prior to the target fiscal year. This is due to the inherent difficulties in preparing detailed advance programs or schedules for field maintenance, since it is essentially an "on-call" support operation.

b. Under the Army Command Management System, field maintenance, unlike depot maintenance, is treated as a subsidiary account, not as a primary program, e.g., Operating Forces (2090) or Major Overhaul and Maintenance (2300). The major budget activity for Operation and Maintenance of Facilities (O&M,F) (9000) consists of station or installation type service support common to all installations and facilities. It includes, as subsidiary accounts—

- 9010 Local HQ Command Administration
- 9020 Local Welfare Services
- 9030 Local Maintenance and Management of Facilities (e.g., utilities)
- 9040 Field Maintenance
- 9050 Local Logistics Services (e.g., supply activities)

c. In accordance with AR 1-11, O&M,F accounts are treated as a form of overhead and are funded on a pro rata basis to the primary programs at each installation. The 9040 field maintenance account is broken down by each technical service. This account is applicable to all Table of Distribution (TD) field maintenance facilities at class I or II installations in CONUS and at installations overseas and to those TOE units assigned to installations in lieu of indirect support or augmentation of TD maintenance facilities. It does not include the activities of TOE field maintenance units classified as Operating Forces; these are funded under the program for "Operation of Tactical Forces" (2010.3000). One important exception to field maintenance budgeting and funding is that fourth echelon Army aviation maintenance is funded out of budget program 2300.

d. The Department of the Army does not break down the field maintenance subsidiary account in presenting or justifying its program budget to the Department of Defense, the Bureau of the Budget, and the Congress. Internally, DA does break out the Operation and

Maintenance of Facilities budget activity during both the budget formulation and execution process. In sending its program guidance to CG, USCONARC, to oversea commanders, and to the heads of the technical services, DA indicates the program budget estimates for field maintenance. In transmitting its program guidance to subordinate ZI armies and the MDW, USCONARC allocates 9000 budgeted funds to each Army by account and by technical service. They may transfer funds within the 9000 activity, between mission programs and among the technical services. For evaluation and control purposes the breakout of 9040 monies is thus preserved at major command, and installation levels.

70. Programing and Budgeting Cycle for Field Maintenance

a. During budget formulation and execution the data flow two ways. Guidance and directives are transmitted from DA to installation commanders via USCONARC or oversea theater commands, the armies, and the installation commanders. Meanwhile, the field maintenance shop commanders transmit requirements information up the command chain. Higher commands consolidate the budget requirements, relate them to estimate available funds, and make necessary adjustments. In preparing the guidance for field maintenance program budgets, DA, USCONARC, oversea theater commanders, and ZI Army commanders, consider past and current experience, activations and inactivations, maneuvers, introduction of new equipment, deadlines, backlogs, and operating costs at installation levels. Similar consideration is given to these factors as they pertain locally. Responsibility for TD field maintenance programing and budgeting is shared by the shop officers, technical service staff officers, the G-4, Comptroller, and the commanding officer of class I and II installations. Most installations have a program and budget advisory committee to assist the post commander in preparing and executing this budget.

b. *The Basic Cycle for TD Field Maintenance Units.* The USCONARC and oversea Command Operating Programs are usually issued by February (FY X-4 months) to the armies. In

May, the installation commanders usually receive dollar guidance for entire post operations from Army commanders. The installations then prepare a breakout of the O&M,F activity to show required 9040 budgets, by technical service, based upon experience and projected equipment densities. A station Operating Program or Budget is prepared for the Army commander, and after the latter has made necessary adjustments, the Annual Funding Program is sent to the installation commander. This is usually received in late June. This cycle is similar for class II installations, except that their guidance and directives come from the technical service headquarters.

c. TOE Programing and Budgeting. The programs and budgets for TOE field maintenance units are accomplished by the ZI and oversea armies based upon equipment densities, projected operations and experience factors correlated with the TOE's. The units themselves do not prepare formal Operating Programs or Budgets.

71. Programing and Budgeting for Organizational Maintenance

a. By its very nature, organizational maintenance provides little opportunity for direct programing and budgeting. Technical assistance and repair parts normally are the only elements of first echelon maintenance for which some provision must be made. Proper programing and budgeting for these two categories is accomplished by giving responsibility for parts supply and technical guidance for each organizational unit to a field maintenance or depot shop.

b. Although somewhat more complex, second echelon maintenance provides little more opportunity for programing or budgeting at the organizational level than first echelon maintenance. As with first echelon maintenance, technical assistance and parts are supplied and budgeted for by the responsible field maintenance shop or depot. Provisions for wages are minimized by virtue of the fact that most "specially trained personnel" are military.

CHAPTER 6

FINANCIAL MANAGEMENT AND ARMY MAINTENANCE

Section I. ARMY FINANCIAL MANAGEMENT

72. General

The resources of the Army maintenance system—personnel, equipment, supplies, and services—are represented by the common denominator of money. In this period of heavy mission demands and fiscal austerity, it is not enough to simply develop a sound program budget. It is equally important that funds be allocated on a priority basis, that performance be stringently measured against costs, and that the dollars be spent prudently. These, in essence, are the functions of financial management, and they are the concern not only of comptrollers, but of all managers in the Army maintenance system.

73. Army Financial Management Plan

a. The Army Financial Management Plan is a collection of the various financial control methods by which the Army manages its funds. Public Law 216, as amended, reorganized fiscal management in the Military Establishment. It placed comptrollers in the Department of Defense and the military departments; it forced the integration of appropriation and fiscal accounting by requiring the performance budget; it called for accounting methods that would measure the costs of programs and activities; and it authorized the use of revolving funds to finance industrial and commercial activities.

b. The Army Financial Management Plan, as set forth in AR 37-5, has two goals.

- (1) Improvement of operational performance through the assignment of specific responsibility for the evaluation

and control of the cost of labor, supplies and services by those who actually cause the expenditures.

- (2) Integration of item and financial accounting for materiel, thereby affording the means for improved inventory control.

c. The major elements most pertinent to logistics and maintenance may be grouped as follows:

- (1) Basic Accounting Systems.
 - (a) Integrated Accounting.
 - (b) Financial Inventory Accounting.
- (2) Asset Control System: the Stock Fund (consumables; not PEMA items).
- (3) Operations or Command Control Systems.
 - (a) The Industrial Fund.
 - (b) Consumer Funding.

d. Accounting systems were established to provide the necessary accounting and book-keeping data in an integrated and compatible form. The Stock Fund is the chief means for controlling the Army's vast inventories of minor secondary items and repair parts by use of a revolving fund controlled by commodity groups. The fund's revolving nature constitutes its control feature by providing built-in checks for the Stock Fund Manager, who must balance his expenditures with consumer receipts. The operations control systems follow regular command channels and provide a unified means for commanders to relate and control mission and dollar resources.

Section II. BASIC ACCOUNTING SYSTEMS

74. Integrated Accounting

a. Integrated accounting is a term which describes the unification and standardization of the various dollar accounting systems formerly used by the Army. The revised accounting structure has integrated the formerly unrelated systems to provide more effective administrative control over resources and to provide a sounder basis for development and evaluation of cost type programs and budgets.

b. In accordance with AR 37-5, integrated accounting provides a unified system of accounting for: supplies other than those included in the stock fund and industrial fund; the costs of operations; and all appropriated funds, including those for depot and field maintenance under the Operation and Maintenance, Army (O&M,A) appropriation. It also has provided a basic classification structure which gives a common identification of funds in order to relate programing and budgeting to financial management.

c. Control is exercised by the use of general ledger accounts and related subsidiary accounts. The latter are maintained in connection with general fund accounting at installation levels and include financial inventory accounting, revenue accounting, fixed asset accounting, and consumer fund transactions with the Army stock fund (AR 37-108). Responsibility for staff supervision of the accounting function rests with the installation comptroller. Establishment and maintenance of the accounting system are responsibilities of the finance and accounting officer, under supervision of the comptroller.

75. Financial Inventory Accounting (FIA)

a. Financial Inventory Accounting is a system whereby the dollar is applied to inventories of materiel, supplies, and equipment held as stock on records of property accountability in the Army supply system. Financial Inventory Accounting is in effect at CONUS and oversea depots, and at certain CONUS class I and II installations operating under provisions of AR 711-16. It does not pertain to those inventories which are in possession of troops and other

activities for which quantitative accounting is authorized, to fixed assets, or to other inventories excepted by DA regulation.

b. Prior to introduction of FIA, supply accounting was conducted primarily on a quantitative line item basis. This latter type of accounting is essential to operating control of supply, but it does not measure economy of supply. Financial Inventory Accounting was instituted not as a replacement to line item accounting but as a supplementary data reporting system designed to provide a better method for evaluating and controlling the costs of inventories. Basically it enables commanders and supply managers to determine by selected categories of items—

- (1) the value and nature of inventory transactions over a given period; and
- (2) the inventory position as of a given periodic date, particularly the balance of assets against requirements.

c. For recording and reporting purposes, all items in the Army supply system have been divided into about seventy categories of similar items, such as clothing, medical supplies, handtools, lumber, and photographic equipment. Each item has been given a standard price in order to cumulate dollar values on the inventories overall and by categories. Depot and installation technical service supply managers use two reporting devices to provide data on inventory transactions and on inventory status.

- (1) *FIA Statement of Inventory Transactions (DA Form 1257)*. This is a summary form, filed quarterly, which reflects by total technical service inventory (not by category) the increases, decreases, and intransit transactions for each quarter.
- (2) *FIA Supply Management Report*. This report is issued in series: DA Form 1886 for CONUS depots; DA Form 1887 for installation inventories; and DA Form 1888 for oversea inventories. These reports, which are also filed quarterly, indicate inventory assets and requirements status.

d. The various levels of command use the data collected by FIA reports to achieve more effective and economical use of resources. These reports and data, in fact, are used for similar purposes as a part of the Army Command Management System. In preparing an Operating Budget, the FIA report would indicate current stock status in relation to programed objectives and requirements. It might also reveal to a local commander and higher headquarters the efficiency of accountable property officers in computing stock requirements as related to issue and return data. In the maintenance area, an installation's DA Form 1887 can be used to make a comparative analysis of total serviceable assets, total requirements, and un-serviceables scheduled for repairs. The service-

able assets of a certain category item might exceed total requirements, yet a large dollar volume of this category inventory may be scheduled for repair. This type of financial imbalance revealed on the FIA report would call for an explanation in the reporting officer's narrative report and a further check against line item records.

e. Financial Inventory Accounting primarily serves to identify problems and to guide commanders and supply managers in attaining more efficient overall financial management of inventories. It is a vital ingredient in measuring supply economy and in justifying to Congress Department of the Army appropriations for continued effective supply support.

Section III. ASSET CONTROL: THE ARMY STOCK FUND

76. Definition

a. The Army Stock Fund is a working capital fund used to finance, on a reimbursable basis, the procurement and supply of minor secondary items and repair parts (usually consumable items), for which a fairly uniform, recurring demand exists. Ranging in cost from less than one cent to more than \$50,000, the stock funded items compose 90 percent of the Army's line item inventory. Included are repair parts, items of clothing, subsistence, and petroleum products; excluded are such major items as aircraft, missiles, special weapons, tanks, vehicles, crane shovels, and artillery, which do not meet "the general provisioning rule" as defined in AR 37-60, "that, in general, there must be a recurring demand for the items . . . so that the stock fund investment therein shall not become frozen."

b. Generally, stock funding is used at the major supply sources of common-use items. All depots, as well as selected stations, in the United States and most oversea depots are included. Organizationally, the Stock Fund is similar to a commercial enterprise, with a home office (Chief of the Technical Service) and branch offices (depots or selected stations) serving customers (generally Army posts, camps, and stations, although some Navy and Air Force cross-servicing is also accomplished).

77. Operation

a. In operation, except for the difference in the kinds of items funded, the stock funded installation works much like the industrially funded activity. The revolving fund concept is the same. Under a stock fund charter, the supply activity's inventories are given a dollar valuation and capitalized, and cash from the overall stock fund is added for working capital and used to replenish inventory and fund accounts receivable. When customers pay their bills for supplies they have ordered, the cash is replenished. In this way, the stock funds revolve.

b. Normally, each stock-funded item has a single standard price (AR 735-7) determined by the National Inventory Control Points. This includes—

- (1) the current market or production cost at the time the price is set;
- (2) the transportation costs for shipping the items to the first destination in the stock fund supply system; second destination transportation costs are included for items under single managementships;
- (3) a surcharge for net losses and related expenses. This surcharge, like the transportation charge, is usually ap-

plied as a percentage factor to an item's current market cost and is an estimate of the amount necessary to keep the fund's working capital intact.

c. Expenses such as labor, warehousing, repacking and other functions of supply administration incurred in processing the inventory are not included in the standard price. The storage and control of stock-funded and non-stock-funded items in the same warehouse by the same personnel make cost allocation difficult; accordingly, all supply administration costs are budgeted and accounted for as a separate element of the annual Army appropriation for operation and maintenance.

d. Price lists are supplied to customers, reviewed periodically, and changes publicized in advance. The stock fund attempts to break even. Due to price changes or the timing of sales, the fund may show a profit or loss, but these fluctuations usually even out over a period of time.

e. The purposes of the stock fund are to—

- (1) provide a simplified means for consolidated management, financing, control, and accounting for the procurement and inventories of those items of materials, supplies, and equipment, the costs of which are chargeable, when issued for use, to a number of consuming activities;
- (2) facilitate improved financial control of consumption of material included in such stocks through budgeting, financing, and accounting for the use of such material at station level; and
- (3) provide a means for financing the acquisition and holding of stocks for materials, supplies, and equipment which are distributed, in part, through sale to personnel of that department or other agencies of the Department of Defense (other than those items financed through nonappropriated fund activities such as exchanges), thus simplifying appropriation accounting and giving greater financial flexibility in these operations than is available by any other means.

f. Stock-funded activities combine the techniques of Financial Inventory Accounting and financial reporting as control devices. The two basic inventory reports are—

- (1) The Statement of Inventory Transactions (DA Forms 2065 and 2066), which reports the dollar value of the opening inventory, increases and decreases by type during the reporting period, and the closing inventory;
- (2) The Supply Management Report (DA Forms 1886, 1887, and 1888), which lists in dollar terms and by inventory category, certain inventory control data. Included are such items as total stock on hand, the serviceable peacetime inventory, the mobilization reserve inventory, the contingency retention inventory, and the excess stock on hand. A series of logistics ratios computed from the data permit analysis of the report.

g. The Stock Fund emphasizes manager control and flexibility. The manager is reasonably free to time purchases to take advantage of favorable prices and is encouraged to increase stock turnover and reduce inventory. Cost control is stressed, and the costs of items are distinctly brought out, particularly to the consumer.

h. With the introduction of stock funding at the depot level, appropriated funds (a portion of the Operation and Maintenance, Army appropriation) were given to the consuming agencies. These dollar resources, known as consumer funds, are used to purchase from the stock fund the supplies formerly issued free. (Consumer funds are also used, less frequently, to reimburse industrial funds.) Thus, control over consumption is placed with the user rather than the supplier. Cost of performance budgets can be developed on the basis of use rather than procurement, with the user required to justify these budgets and control the funds granted him.

78. Problem Areas

a. Despite the tighter financial controls permitted by stock funding and consumer funding, certain problems do exist. First, one often-

cited advantage of stock funding is that the manager is not limited by annual appropriation restrictions and can gear procurement to market conditions and customers needs. Each year, however, obligational authority for procurement must be obtained from the Bureau of the Budget and the Office, Secretary of Defense. This yearly apportionment and quarterly allo-

cation of the appropriated stock funds restrict the manager's flexibility.

b. The effectiveness of stock funding in wartime has also been questioned. In emergency situations troops may need additional supplies immediately, and procurement funds must be found and the delay of order processing must be avoided.

Section IV. OPERATIONS CONTROL SYSTEMS

79. The Army Industrial Fund

a. The Army Industrial Fund is a revolving fund control system, but it is applied to a different type of management unit than the Stock Fund. It is used to finance and control, on a reimbursable basis, the operations of industrial and commercial type activities. It is an operations rather than an assets control system (AR 37-71).

b. Each activity chartered under the industrial fund is capitalized in the form of cash; accounts receivable; inventories (raw materials, supplies, work in process, and finished goods); and other current assets, with enough funds to support its operations. These funds are used to pay for the costs of labor, materials, and overhead incurred in completing customers' orders for products or services. Such costs are accumulated against orders, and, either periodically or when the work is finished, the customer (usually an Army activity, although cross-servicing of Navy and Air Force activities is also performed) is billed. The customer's payment of his bill, either from appropriations or other funds, reimburses the fund and makes capital available for new orders. In this way, as the cycle of manufacture and reimbursement is completed, the industrial funds are considered to have "revolved," thus maintaining the working capital.

c. Not all costs are included in the price of the end product. Military pay and allowances and depreciation on Government-owned plant and equipment, are not charged to Federal customers. Land, and plants and equipment, used by industrial funded activities are financed from separate appropriations and are not capitalized under the fund. This failure to charge

for depreciation and military pay is the only real difference between industrial fund and commercial operations.

d. The principal objectives of the Army Industrial Fund are to—

- (1) provide managers of industrial and commercial type activities with the financial authority and flexibility required to procure and use manpower, materials, and other resources effectively;
- (2) establish one uniform financial management system for commercial and industrial type activities of the same category;
- (3) control costs in line with workloads actually generated by customer orders;
- (4) create buyer-seller relationships between industrial and commercial type activities and those agencies which budget for and order the end products of services in order to provide incentives for efficient management;
- (5) enable ordering agencies to budget and account on an end-product basis, as they do when they buy from private contractors.

e. Industrial funded activities use working capital funds as control devices to attain these ends; in addition they use various techniques of management control which have proved successful in private commercial and industrial management. These include cost accounting systems (usually on a job order basis), inventory accounting costed on a use rather than purchase basis, engineered time standards, predeter-

mined prices, and production controls. Overhead and direct-cost levels are developed for a series of production levels at each installation, and actual operations are measured against an operating budget. The Industrial Fund Manager has more latitude than the commander of an appropriation funded depot in allocating and controlling his resources. He also has a greater incentive to increase working capital and inventory turnover, to program and budget accurately, and to reduce costs.

80. Consumer Funding as a Control Device

The operation of both the Stock Fund and the Industrial Fund depends upon "purchases" made by the various customers of these funds. These purchases are made from so-called "consumer funds," which are actually the appropriated funds (chiefly from the O&M,A appropriation) given to an activity or installation, and allocated by the commander of these activities to obtain its supplies. With these consumer funds, a commander may procure supplies from the Stock Fund or from local sources. Under consumer funding, the station obligates its appropriated consumer funds when it requisitions supplies, and the "consumption" occurs at the time of issue to the ultimate user. The Army is able to evaluate supply efficiency at depots, posts, camps, and stations in terms of dollars. Consumer funding thus serves as a valuable operations control device as well as a means of funding (AR 35-252).

81. The Army Command Management System

a. The Army Command Management System directs that the commander of a nontactical activity plan, administer, and control the resources needed to carry out his assigned mission. It is applicable to appropriation funded activities. The commander forecasts his workload and its costs and then receives the necessary funds, manpower, and materials; he directs and controls his activity's operations and reports the results to his superior. The ACMS applies to the management of major activities and operating programs at all levels of command. It is not a part of the Army Financial Management Plan, but it embodies complementary concepts of supply economy and decen-

tralized management. It also uses several of the same budgetary and accounting control devices, such as the FIA reports.

b. At depots, the Army Command Management System places responsibility for financial management in the hands of the depot commander. All funds come from the cognizant technical service, and all reports go to it. At each depot, the commander is held responsible for accomplishing the depot's annual program. He helps to plan this program by estimating his workload and its costs. From this forecast he is given, from the appropriate technical service's O&M,A appropriation, a sum of money which covers all depot activities. Within certain limits he can distribute this money as he sees necessary. He is expected to use all management and accounting controls that will improve the effectiveness of his operation.

c. The ACMS for depots integrates programming, budgeting, and funding within the Army management structure. It provides for preparation of a cost-type operating budget and for implementation of program controls. ACM reporting systems have been developed to show work performance (by performance analysis), resources utilization (by cost accounting), and mission accomplishment. Operating Cost and Performance Reports are used to compare actual with planned performance. The major reports for evaluating depot operations are the DA Form 1535 (Depot Operations—Workload and Cost) and DA Form 1535-1 (Depot Operations—Program and Schedules). The programmed work is compared quantitatively with the work performed during each period. The efficiency of the work is measured by a comparison of standard unit costs with actual unit costs during the period. Deviations of actual performance from programmed performance, and deviations of actual unit cost from standard unit costs, are called variances and measured as percentages of the programmed or standard amounts. Program tolerances (usually plus or minus 15 percent) are established for each depot function such as overhaul or modification. Deviations which exceed tolerances ordinarily must be reported and explained to the technical service headquarters.

Section V. APPROPRIATION FUNDING

82. Budgeting and Funding Relationship

Funds are the dollar resources, expressed in terms of obligational authority, required to finance payrolls, services, and supplies ordered without reference to time of use. Pursuant to Public Law 803, the Army employs the cost-of-performances type of budgeting, whereby the cost of programs incurred or to be incurred during a given budget period must be indicated in addition to the required funds. Cost of performance is important not only during budget formulation and execution but throughout the fiscal year. The depot maintenance control reports (DA Forms 1508 and 1508a) emphasize costs of performance regardless of source of funds. Funds and funding remain an equally vital aspect of Army maintenance; the authorized funds constitute the dollar resources against which obligation may be made by a maintenance activity.

83. Appropriation Funding for Depots and TD Field Maintenance Shops

a. Quarterly Allotments. The Annual Funding Program, which is received by depot and installation commanders in June, is related to the Operating Budget. It indicates by program (or major activity) and code the total funds which may be obligated by the depot commander for his entire fiscal year budget. This total fiscal year funding program, however, is not an authorization for obligation of the entire annual funds. The Bureau of the Budget, Department of Defense, and the Department of the Army actually release funds on a quarterly basis in order to control expenditures and prevent overobligation and to preserve some fiscal management latitude during the year. It is generally considered that the danger that an activity or command will expend its funds before the fiscal year expires is lessened by making funds available quarterly. Quarterly control not only minimizes overexpenditures, but also gives the Army an opportunity to cut the spending rate for a given quarter in less critical areas in order to make funds available for unexpected priority needs of another activity. The cognizant technical service or army comptrollers make quarterly allotments of funds to

depots or installations in specified amounts under provisions of AR 37-20. The normal schedule for transmitting these allotments is: June, mid-September, mid-December, and mid-March.

b. Depot Allotments. The technical services differ in the detailed degree to which they distribute quarterly allotments. However, for programming purposes the technical services break out the 2300 Budget Program in the Operating Budget by Budget Activity Account (BAA) e.g., account 2310 for Major Overhaul Activities which is further broken out by Summary Cost Account (SCA) such as 2310.2000 Combat Vehicles. Related costs and performance can therefore be determined. A further breakout of the Summary Cost Account, called the Cost Account (CA) e.g., 2310.2100 or 2310.2200, would identify the types of equipment to be overhauled. In order to give depot commanders optimum management authority, as well as responsibility, the allotment is confined to the major activities. A depot commander may *not* transfer funds from budget program 2200 to 2300. He may, however, shift funds internally among accounts within these activities.

c. Field Maintenance Allotments. At installation levels, the station commander receives his Annual Funding Program and subsequent allotments by major activity. The installation commander may not transfer appropriated funds, for example, from program 2100 (Training Activities) to 2200 (Central Supply Activities) without approval of the ZI Army Commanders, or—at class II installations—without approval of the cognizant technical service. The Operation and Maintenance of Facilities (9000) account is funded out of the major programs on a pro-rata basis, using predetermined percentages. It is noted that O&M,F is only on overhead cost account, not a formal budget program or a funding account. Obligations can only be cited against the carrier programs. Within the O&M,F cost account, the Commander, acting through his comptroller and his Program Budget Advisory Committee, may make transfers locally. Changes in TOE's of units, station reorganizations, unscheduled maneuvers, and unexpected issue of new equipment which con-

tribute to difficulties in programing and budgeting also disrupt funding. Technical service staff offices and shop chiefs must be continuously alert to changes, anticipate them when feasible, and be prepared to respond when they

arise. The response may consist of a logical, effective plea to the commander for more funds or, more likely, may be a firm appraisal of priorities, and an adjustment of a shop's quarterly program to obtain emergency funds.

PART THREE

DEPOT MAINTENANCE

CHAPTER 7

THE IROAN TECHNIQUE AND DEPOT ORGANIZATION

Section I. THE IROAN TECHNIQUE

84. General

a. The maintenance technique known as "Inspect and Repair Only as Necessary" (IROAN) was developed for the purpose of eliminating unnecessary maintenance costs and still achieving published maintenance standards. The IROAN technique is applicable to all categories of maintenance. IROAN implements the principles of economical maintenance operations by a thorough inspection of major items and components to diagnose their troubles before beginning repair or initiating action for replacement. This inspection is facilitated by the use of modern diagnostic equipment. Highly skilled and experienced inspection personnel are essential to the success of this program. Inspection includes essential disassembly or teardown in order to determine the cause of unserviceability and to assure that serviceability standards are attained. The cause of the unserviceability is either determined or predicted from the inspection and only that trouble located is remedied.

b. In fifth echelon overhaul, the proper practice of IROAN requires that *all* dynamic assemblies are sufficiently disassembled to insure that inspection is adequate and serviceability standards are assured. The objective of IROAN is to do sufficient but not unnecessary disassembly and replacement of parts.

c. In 2d, 3d, and 4th echelon maintenance, IROAN requires that only the assembly or assemblies giving trouble are repaired. In addition, the emphasis in IROAN at these echelons is to continue the use of parts, com-

ponents, and assemblies to the limit of their designed serviceable life and not replace them merely for wear.

d. Maintenance serviceability standards are those standards established by the chiefs of technical services which will assure that end items, components, or assemblies will function properly and are capable of accomplishing their intended missions.

e. Coupled with this inspection is the action by maintenance supervisory personnel to hold to a minimum time-consuming and costly labor operations through the use of work simplification, procedure analysis, and time performance standard programs.

85. Diagnostic Equipment

a. The technical services must push the development of diagnostic equipment that is capable of pinpointing defective parts, components, or assemblies without teardown of major items. Application of computer controlled checkout equipment offers a greatly expanded capability in performing detailed fault diagnosis and an analytical evaluation of a spectrum of test results on a unit under test. No other checkout technique offers such potential for reduction in supporting maintenance skills, increased efficiency of maintenance effort, and concurrent generation of logistics as well as operationally useful data.

b. Such equipment will permit full implementation of the IROAN technique for overhaul programs and monitoring the condition of stocks in the depots. Truck mounted, it will

be capable of complete item checkout as well as piece part diagnosis at field maintenance

level. Packaged in a carrying case, it will be capable of on-site fault location.

Section II. ORGANIZATION FOR DEPOT MAINTENANCE

86. Depot Maintenance Organization and Functions

a. The mission of the depot maintenance shop is to return unserviceable equipment to useful operating condition by means of overhaul and/or complete rebuild. The primary mission of depot maintenance is to support supply on a repair-and-return-to-stock basis. Depot maintenance shops employ production line, bay shop or bench type methods of operation as appropriate. They contain the most extensive facilities, the most specialized production equipment, and the largest number and diversity of technical skills in the Army maintenance system. Depot shops maintain close liaison with field maintenance units to insure adequate and timely support and to provide for an orderly flow of work from lower echelons to depot overhaul. Civilians constitute the work force in CONUS depots, whereas oversea depot personnel may be military or indigenous employees.

b. There are two kinds of depots: the branch depot, which stocks and issues commodities of only one technical service and is administered by that service, and the general depot, which stocks and issues commodities of several services and is administered by the Quartermaster General (figs. 8 and 9).

c. AR 780-10 describes the relationship of the Quartermaster Corps to other technical services that have supply or maintenance activities located at a general depot. Normally, the Quartermaster General, through his designated general depot commanders, exercises administrative and operational control over all activities within the depot including the activities of the other technical services. In matters of maintenance programing and budgeting, the programs are prepared by the cognizant technical service and transmitted to the Quartermaster General for execution; budgeting and funding are done directly by the Quartermaster Corps. The regulation provides that certain

class II activities, such as depot maintenance, may remain under primary control of the parent technical service at general depots. In such cases the relationship between the general depot commander and the class II activity, as stated in AR 780-10, would be "that of landlord and tenant." The commanders of class II activities at a general depot are selected by their cognizant technical services rather than by the Quartermaster General. In all instances the establishment of class II activities at general depots are subject to DCSLOG approval.

87. Typical Depot Maintenance Organization

A typical depot maintenance division will include the following organizational components:

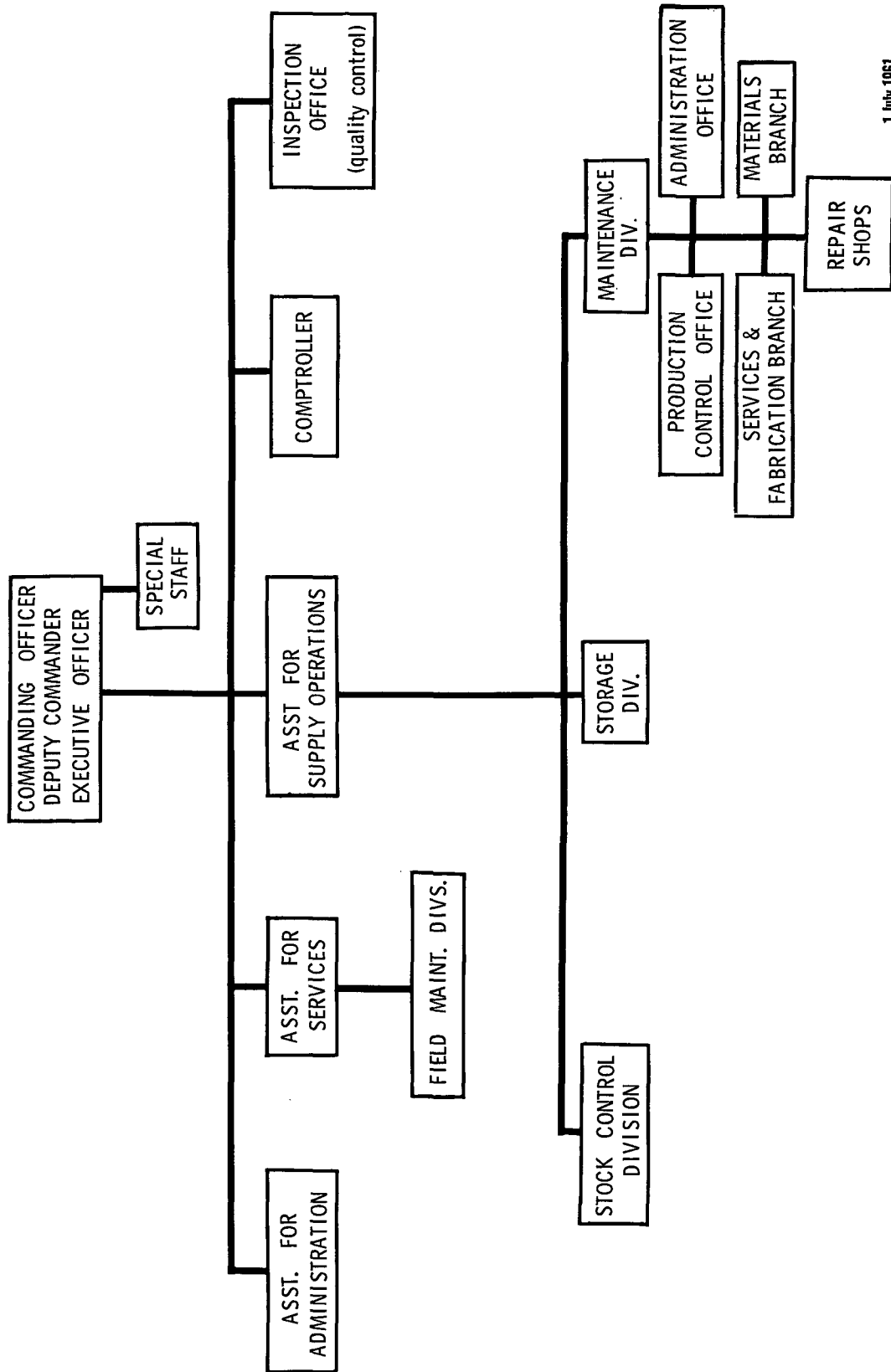
a. The depot maintenance chief, who supervises the entire shop and is responsible for its operations. At a branch depot, he reports to the Director for Supply Operations; at a general depot, he reports to the cognizant directorate.

b. A production control section, which assists the shop officer by forecasting and scheduling the depot maintenance shop workload. This section establishes priorities for overhaul work, balances the shop workload, and develops cost and production standards. Through performance analysis, it recommends to the maintenance chief changes to improve shop operations; the section also develops new production layouts and flow charts to meet changing maintenance requirements.

c. A supply section which forecasts and maintains levels of operating supplies and repair parts. It stores these supplies, records consumption data, and maintains the maintenance division's toolrooms.

d. An inspection section or office, which supervises all shop inspection, including the inspection of unserviceable equipment and in-process inspection (quality control). Inspection personnel also survey overall shop practices. Preferably, the inspection unit at some

MAINTENANCE ORGANIZATION OF A TYPICAL BRANCH DEPOT



1 July 1951

Figure 8. Maintenance organization of a typical branch depot.

SPECIAL STAFF DEPOT COMMANDER ^{1/} (INCLUDES EXECUTIVE OFFICER) -					
SPECIAL STAFF ^{6/}					
ASSISTANT FOR ^{2/} CHEMICAL SUPPLY OPERATIONS		ASSISTANT FOR ^{2/} ENGINEER SUPPLY OPERATIONS		ASSISTANT FOR ^{2/} QUARTERMASTER SUPPLY OPERATIONS	
ASSISTANT FOR ^{2/} ARMY MED SERVICE SUPPLY OPERATIONS		ASSISTANT FOR ^{2/} TRANSPORTATION SUPPLY OPERATIONS		ASSISTANT FOR ^{2/} SIGNAL SUPPLY OPERATIONS	
ADMINISTRATIVE & LOGISTICAL SUPPORT					
DIRECTORATE FOR WAREHOUSING TECH STAFF ADMINISTRATIVE STOCK CONTROL STORAGE TRANSPORTATION		DIRECTORATE FOR MAINTENANCE TECH STAFF ADMINISTRATIVE INSPECTION SHOPS, SUPPLY REPAIR SHOPS		DIRECTORATE FOR POST OPERATIONS ADJUTANT INDUSTRIAL RELATIVES PROVOST MARSHAL POST ENGINEER POST COMMAND	
DIRECTORATE FOR COMPTROLLER BUDGET & FUNDS CONTR FINANCE & ACCOUNTS INTERNAL AUDIT DATA PROCESSING MANAGEMENT ASSIST		ATTACHED ^{5/} CLASS II ACTIVITIES			
ASSIGNED ^{3/} SPECIAL MISSIONS ^{4/}					

<u>1/</u>	WHEN A DEPUTY COMMANDER AND AN EXECUTIVE OFFICER ARE ASSIGNED ONE WILL SERVE AS DIRECTOR FOR POST OPERATIONS.	
<u>2/</u>	ADDITIONAL DUTY FOR SENIOR TECHNICAL SERVICE REPRESENTATIVE WHO FUNCTIONS AS DIRECTOR OR DEPUTY DIRECTOR.	5/
<u>3/</u>	TO PLACE AN INDIVIDUAL OR MILITARY UNIT UNDER THE CONTROL OF A SPECIFIED COMMANDER BY ORDERS WHICH CHANGE THE PARENT HEADQUARTERS OF THE AFFECTED INDIVIDUAL OR MILITARY UNIT.	DEFINED AS AN INDEPENDENT UNIT OR ACTIVITY ATTACHED TO DEPOT FOR SPECIFIC SERVICES UNDER LIMITATIONS PRESCRIBED IN ATTACHMENT ORDERS BUT WHICH REMAINS UNDER OPERATIONAL CONTROL OF ITS ASSIGNED COMMAND.
<u>4/</u>	DEFINED AS AN ASSIGNED INDEPENDENT UNIT OR ACTIVITY WHICH APPROPRIATELY SHOULD BE SHOWN AT THE DIRECTORATE LEVEL BUT WHICH SHOULD NOT	6/
		THE SPECIAL STAFF MAY INCLUDE: LEGAL OFFICER, DEPOT INSPECTOR, INTELLIGENCE OFFICER, PUBLIC INFORMATION OFFICER, DEPOT SURGEON, FOOD SERVICE ADVISOR, PLANS AND TRAINING OFFICER, ETC.

Figure 9. Maintenance organization of a typical general depot.

depots is not a component of the maintenance shop but an independent unit reporting directly to the depot commander.

e. The shops which actually perform the maintenance work, such as the overhaul shop, the rebuild shop, and the equipment modification shop. Each shop is headed by a shop

supervisor who directs the work and insures compliance with operating procedures and safety regulations. These shops may be divided into branches, each headed by a foreman who assists the shop supervisor.

f. An administrative section, which performs clerical and personnel duties.

CHAPTER 8

MAINTENANCE SCHEDULING FOR DEPOT OPERATIONS

Section I. PROGRAMING AND WORKLOAD DETERMINATION

88. Nature of Scheduling

a. In a broad sense, maintenance scheduling is in much the same relation to programing that programing is to long-range planning. A program is intended to implement a plan, a schedule to outline the specific means by which the more immediate objectives of Army programs are to be accomplished. No definite dividing line can be drawn between programing and scheduling; scheduling is merely a continuation of the process of articulation, particularization, and reformulation of the Army strategic plans to meet constantly changing conditions. The broad objectives of scheduling are the same as those of programing and budgeting, i.e., to promote a more effective utilization of available maintenance capacity by providing a balanced distribution of work and by insuring the availability of resources for the performance of such work. Unlike programing, however, scheduling deals in specifics: specific installations, definitive workloads, and finite periods of time.

b. Maintenance scheduling is carried out in two steps: workload determination; and production scheduling. Workload determination involves the generation of facts and figures as to the size and nature of workloads to be assigned to each installation. Of basic concern is the type and number of items to be repaired, overhauled, or rebuilt, by whom and during what specific period of time.

c. After the workload has been computed and assigned to various installations, the installations themselves draw up production schedules and work orders delineating the methods and procedures to be followed during overhaul and the resources necessary to process the assigned workload. This second phase of maintenance scheduling is directed to the co-

ordination of current resources, i.e., labor, parts, funds, and plant capacity, to accomplish the assigned workload in the most effective manner possible.

89. Development of Maintenance Requirements

a. Maintenance programing begins with the issuance of the five Control Programs and the Preliminary Program and Budget Guidance from the Department of the Army to the technical services and major Army Commands. During the review and reappraisal process that follows, DCSLOG informs each technical service of the more specific program objectives for maintenance.

b. Using this information, the cognizant National Inventory Control Point (NICP) within each technical service develops the Army's probable worldwide requirements during the following fiscal year for each major item of equipment for which the NICP is responsible. This procedure involves applying TOE and TA factors to anticipated troop strengths and making appropriate additional allowance for special programs, supply levels, expected attrition, in-place reserves, and other pertinent factors. From these worldwide requirements, the NICP then deducts the present number of serviceable equipments needed. Subsequently, the NICP decides whether to meet these additional requirements from procurement of new equipment or from maintenance (usually overhaul) of presently unserviceable equipment.

c. In addition, the NICP's also process overhaul requirements for other military departments and the MAP program.

d. When the NICP receives approval of its projections and conclusions from the chief of the technical service, it informs the cognizant commodity managers of the total number of

unserviceables which are to be overhauled at CONUS depots. The NICP, in turn, appraises its CONUS depot shop capabilities, and schedules the unserviceables into specific depots. Cognizant oversea commanders are responsible for workload scheduling at oversea depots.

e. As an aid in determining the present number of serviceable equipments and in controlling inventory levels, each NICP maintains a consolidated worldwide record of the serviceability condition of each of its major items of equipment. This record is based on reports from field activities, CONUS and oversea depots, and due-in procurement reports. It includes a stock status card for each item of equipment which gives the name, Federal stock number, and location of the item, and a Condition Reservation Code (CRC) number which indicates the status of repair of the item.

90. Condition-Reservation Code Structure

a. The Condition-Reservation Code (CRC) numbers and their definitions are presented below. AR 735-15 required that technical service implementation of these codes designate the codes which are authorized for use by that technical service. Codes not authorized for use by the technical service are not to be used for another purpose. The code structure is as follows:

Condition-Reservation

- Code 1---Serviceable---suitable for immediate unlimited use.
- 2---Serviceable---suitable for immediate limited use.
- 3---Serviceable---suitable for use after minor processing or repair and/or addition of missing attachments or components.
- 4---Reserved for chief of technical service.
- 5---Unclassified (and suspended).
- 6---Unserviceable---economically repairable---not scheduled for repair.
- 7---Unserviceable---economically repairable---scheduled for repair.
- 8---Unserviceable---not economically repairable.
- 9---Suspended (or reserved for chief of technical service if unclassified and suspended are combined in code 5).
- 0---Reserved for chief of technical service.

b. Explanatory remarks.

- (1) *Condition-Reservation Code 1.* Is used to record group A (AR 711-50) new or used supplies possessing original

appearance and serviceability and ready for immediate oversea or domestic use.

- (2) *Condition-Reservation Code 2.* Is used to record group A new or used serviceable supplies other than those reflected under codes 1, 3, 9, and 0, ready for immediate use for limited purpose and/or restricted from issue by the chief of technical service.
- (3) *Condition-Reservation Code 3.* Is used to record group B new or used stocks suitable for use after minor repair, processing and/or addition of missing attachments or components.
- (4) *Condition-Reservation Code 4.* Is reserved for chief of technical service.
- (5) *Condition-Reservation Code 5.* Is used to record group UC supplies which have been identified by stock number and nomenclature, but not examined for condition.
- (6) *Condition-Reservation Code 6.* Is used to record group C supplies which are unserviceable and economically repairable which have not been placed on a repair schedule. (May be made available for limited issue 'as is' by chief of technical service.)
- (7) *Condition-Reservation Code 7.* Is used to record group C supplies which are unserviceable and economically repairable which have been placed on a repair schedule.
- (8) *Condition-Reservation Code 8.* Is used to record group D supplies which are unserviceable and not economically repairable.
- (9) *Condition-Reservation Code 9.* Is used to record all supplies which are temporarily suspended pending analysis, check of physical inventory, suspended shipments, etc., or upon instructions of the chief of technical service. (May be combined with Condition-Reservation Code 5, in which case this code becomes reserved for chief of technical service.)
- (10) *Condition-Reservation Code 0.* Is reserved for use of chief of technical service.

c. The NICP's consolidated record of the serviceability condition of its equipment is based mainly on reports from field activities and CONUS and oversea depots. Except when codes 4, 9, or 0 are involved, inspection personnel at these activities are responsible for making necessary changes to an equipment's code number. The item may then be sent to a depot for depot maintenance, to a cannibalization point, or to a local property disposal officer, as appropriate. Before any overhaul of an unserviceable is begun at a depot shop, however, depot inspection personnel examine the item in detail to confirm or reject the field inspector's reparability estimate. If the item is economically reparable, it is immediately classified as CRC 7 (economically reparable and scheduled for repair). This code precludes any further requisitioning action by another installation or unit. The item then enters the overhaul process. After the item is overhauled, a depot inspector reclassifies it according to its serviceability.

d. In the case of large items which become unserviceable in the field, a preliminary on-the-spot inspection is often conducted by a Regional Maintenance Representative (RMR) or other designated inspector to determine the practicality of overhaul. Should the inspector decide that overhaul is uneconomical, he may recommend to the NICP that the item be reclassified as CRC 8 and cannibalized or otherwise disposed of on the spot, thereby avoiding any transportation costs. Barring unusual demands for the item, the NICP will usually accept the inspector's decision.

91. Economic Reparability

a. The CRC numbering system for unserviceable equipment (codes 6, 7, and 8) is based on definitions of economic reparability. To assist the field inspector or Regional Maintenance Representative in determining whether or not an unserviceable is economically reparable, several systems of evaluation have been adopted by the various technical services. A basic consideration in all of these systems is a comparison of the estimated costs to repair an item with the costs to replace it and even more importantly a judgment as to the value (in terms of service life) that will be restored to

the item if it is repaired or overhauled. Value restored through repair or overhaul may be measured by comparison of subsequent probable maintenance costs after maintenance as compared with probable maintenance costs of new equipment. Obviously, it will not be economical to repair an item if repair will cost more than replacement. In extreme cases, any repairs—no matter how minor—may be "uneconomical" if the unserviceable is obsolete; any decision as to whether to repair or replace a given unserviceable must reflect this policy.

b. In establishing economic repair limits for an item, the cognizant technical service may consider such factors as the item's age, its military criticalness, its CRC classification, the full direct and indirect cost of repair, the cost of inspection, the cost of preparing an item for shipping and transportation charges, the cost of processing at the depot, the cost to replace, the value of the item after repair, and the existing supply of necessary repair parts in the logistics system. As these factors change, economic repair limits are changed. When repair costs exceed the maximum expenditure limit, cannibalization or disposal of the item is undertaken, unless, of course, military necessity dictates otherwise.

(1) *Fixed percentage of replacement cost.*

Under the fixed-percentage-of-replacement-cost method, an unserviceable item is classified as economically reparable if the estimated costs of the repair job, including parts, do not exceed a certain fixed percentage of the value of a new, serviceable item. Variations on this approach have been developed because of differences in estimating repair costs and in defining the value of a new, serviceable equipment. This method should be used only when the value of an item does not diminish with age or use, or when no more practicable method can be devised. This system fails to account for such factors as the age or miles or hours of operation of an unserviceable or the number of times it has been previously overhauled.

(2) *Sliding scale.* A sliding scale system, with decreasing overhaul percentage

limits as an equipment becomes older, is used more extensively. In a scale which is based on the age of the equipment, a limit of 50 percent of replacement cost might be established for the first 2 years of an item's life. This percentage limit might then be successively reduced at the rate of 15 percent per year, until only 15 percent of the value of a new item is allowed for repair costs of an unserviceable which is 6 years old. In addition to age, sliding scales for various equipments have been developed on the basis of the number of times the item has been overhauled, its total hours of operations, its mileage (in case of vehicles), the number of rounds fired, the number of times air dropped and other similar factors.

- (3) *Point system.* This system considers a combination of factors, such as the item's age, number of hours in operation, cost to repair, availability of repair parts, and estimated life expectancy after repair. During preshop inspection, each factor is given a point score; one point might be assigned for each year of age above a certain limit, or for each 1,000 hours of operation. The points for each factor are then totaled. If the score is above a certain prescribed limit, the item is not repaired, barring, of course, such overriding considerations as military necessity or the impossibility of replacement. (A point system—or, for that matter, any system—may be supplemented by a No-Repair list, consisting of items which, because of age, may not be overhauled regardless of the cost to do so.)

c. Any system of determining economic reparability that involves a computation of the estimated costs to repair an unserviceable generates a requirement for simple and accurate determination of costs.

- (1) This requirement has been most effectively solved by the use of a standard CONUS-wide hourly service rate, as representative of both direct labor and

overhead expense, in estimating repair costs. (This rate, multiplied by the number of direct labor hours which it is estimated a given job will require, is then added to the expected costs of repair parts in computing total estimated repair costs.) This method, in effect, ignores any differences in operating costs among the various depot shops. Its chief advantage is its simplicity—all inspectors, Regional Maintenance Representatives, and other personnel who are concerned with making repair or replacement decisions can develop their estimates from the same factor, i.e., the single standard hourly service rate. Thus, cost computations themselves are facilitated, indirect costs are complete, greater overall consistency in repair or replacement decisions is achieved, and the problem of distributing repair criteria to field inspection personnel is minimized. This system recognizes that each depot maintenance shop must perform a certain minimum amount of overhaul work each year in order to continue to exist and serve its mission customers. It also recognizes that maximum operating efficiency is obtained when an individual depot shop can depend on a relatively balanced workload from month to month. By eliminating any comparisons of individual depot operating costs in determining where a particular unserviceable should be sent for repair, the standard hourly - service - rate method facilitates more uniform scheduling by the NMP and, as a result, more balanced workloads at the individual depot shops.

- (2) A second method employed involves the use of actual depot direct labor and overhead costs, rather than standard costs, in computing the costs to repair an unserviceable. Specifically, in computing economic reparability, the field inspector or Regional Maintenance Representative applies the actual direct labor and overhead rates of

either—(a) the depot to which the unserviceable will be sent, as directed by the NMP; or (b) if the actual receiving depot is unknown, the nearest depot which is capable of rebuilding the item. It is argued that this system is more realistic than one which embodies standard cost calculations and that it results in lower overall maintenance costs, since the most efficient depot shops—i.e., those with the lowest repair costs—perform a large portion of the total workload. (Minimum repair workloads must, of course, be maintained at all depots to preserve their operating capabilities.) The system, however, has certain inherent disadvantages—it complicates the task of the field inspector or Regional Maintenance Representative in calculating the costs to repair an unserviceable. He must know beforehand where, if reparable the unserviceable will be sent for overhaul, or the proximate depot which can perform the work, as well as the actual operating costs of this depot. The task of providing up-to-date and complete cost data to field personnel, is in itself, of considerable magnitude, and has not always been accurately done. The operating costs of individual depots are not always comparable, because of variations in the methods of accounting for and allocating indirect costs. Equally important, the system does

not result in consistent repair or replacement decisions. Some depots—with low operating costs—repair unserviceables which other depots—with higher costs—would not.

d. Regardless of whether standard or actual costs are used in computing repair parts, the costs to transport an unserviceable to a depot for repair must be included in the total overhaul estimate. The inclusion of individual transportation costs could be prejudicial to depot shops which are located far from areas of high equipment density and/or from transportation centers and consequently mean average costs should be used. Since transportation costs are true out-of-pocket costs to the Government—specifically to the depot's Budget Program 2220 allocation—they must be included in any determination of economic reparability. The costs of overseas transportation to return an unserviceable to CONUS should be excluded in individual cases only when it can be shown that unserviceables would be ballast.

e. The costs against which the total estimated repair costs are compared are the acquisition costs of the serviceable item as listed in the pertinent Department of Army supply manual pricing guide. If the pricing guide does not contain a listing for the item, the current market price of a like new item may be used. These are standard prices which are referred to as "replacement costs." Standard prices are the last procurement price plus a surcharge. Appropriate regulations concerning the above subject area are contained in the appendix.

Section II. SCHEDULING FOR OVERHAUL

92. National System Scheduling

a. AR 700-5 places the responsibility for scheduling unserviceable items into depots in coordination with the depot maintenance activities.

b. Given the immediate availability of the necessary unserviceable assets, the order of overhaul depends upon the relative importance of each item to the Army. From the first formulation of operating programs to their final implementation, a never-ceasing evaluation and

re-evaluation of the various maintenance programs is carried out at every level of command. Some overhaul projects, such as those for strategically important Military Assistance Program shipments, are often assigned top priorities by the Department of the Army at the direction of the President, Secretary of Defense, or Joint Chiefs of Staff. Other programs may be given a priority status at the technical service level as a result of depleted stocks or increased demands. The depots themselves usually attend to repair-and-return-to-

user items first, assuming, of course, that no higher priority programs have been assigned.

93. Role of the NICP

a. Allocation of workloads among various installations is normally carried out by the National Maintenance Point (NMP). Its allocation decisions usually depend on one or more of the following factors: current workloads, backlogs, resources, capacities, and costs, as well as the present location of the unserviceable economically repairable assets available for overhaul. This information is channeled to the maintenance managers via weekly, monthly, quarterly, semiannual, or annual reports prepared and submitted by each installation. At technical service headquarters or NMP levels the information is extracted and the comprehensive DA Forms 1508 and 1508-1 described in AR 780-66 are prepared. Available and often used are historical analyses of the relative ability of each shop to perform a particular type of overhaul.

b. While in the great majority of cases the NICP determines installation maintenance workloads, some of the depot workload is backup repair support to meet emergency and one-time/nonrecurring demands of lower echelons. These repair-and-return-to-user operations should be scheduled by the local depot, with notification to the NICP.

c. The final step for the NICP in the scheduling process is the preparation of scheduling documents for each installation. The scheduling advice may take the form of a work order

request, or any of a variety of other documents. Whatever the format, the scheduling advice usually states stock numbers, item nomenclatures, quantities of line items, priorities, and any other pertinent data which will aid the depot in preparing its annual production schedule.

d. In the final analysis, the installation receiving the scheduling advice usually decides whether the proposed schedule is realistic. If depot personnel do not believe that the goals set by the NICP are in line with current depot shop capabilities, capacities, and resources, the NICP is apprised of this belief and the reasons behind it. It then rests with the NICP to make appropriate revisions, provide additional resources, or justify the original schedule.

e. The role of the NICP in the scheduling process does not terminate with adoption and implementation of the annual schedule. Constant revision throughout the year is made necessary by innumerable factors, ranging from alterations in strategic plans and primary programs to unanticipated defects in equipment and changes in the available resources of men, money, and material. To compensate for these new factors, supplemental workload schedules must be substituted for those rendered obsolete.

f. Throughout the year the NICP is responsible for insuring delivery to the shop of the proper number of unserviceables at the right time to meet planned workloads and maintain desired backlogs. In this process, it collaborates closely with the maintenance manager.

CHAPTER 9

DEPOT MAINTENANCE OPERATIONS AND PRODUCTION MANAGEMENT

Section I. GENERAL

94. Scope

The major aspect of production that production management must consider—both before and during actual maintenance operations—to keep pace with predetermined schedules is the economical and efficient use of available production resources, i.e., facilities, manpower, and materials. Adequate production scheduling for maintenance operations is the essential first step toward securing successful production performance.

95. Production Scheduling

Production scheduling consists of—

- a. determining the production resources, e.g.,

funds, economically reparable unserviceables, parts, labor, tools, materials, and machinery, which will be required to effect a given maintenance program; and

- b. establishing production procedures to accomplish the depot maintenance mission.

Depending on the scope and complexity of a particular maintenance program, production procedures may take the form of detailed Standard Operating Procedures or the less-detailed DA Form 811 (Work Request and Job Order). In either case, the success or failure of all subsequent maintenance operations will depend on the adequacy of such procedures.

Section II. ADMINISTRATION

96. Nature of the Maintenance Shop Labor Force

a. Unlike many industrial concerns which are able to achieve flexibility in their labor force by hiring workers in periods of peak productive output and laying them off when volume declines, the labor force at most depot and field maintenance shops is fairly inflexible. This is true for a number of reasons. In the first place, many maintenance shops in the CONUS are located in relatively isolated, nonindustrial areas. Often, the military and civilian personnel who work at an Army installation form a large percentage of the population in the area. Under these circumstances, if labor requirements at the maintenance shop increase, it is often difficult or impossible to hire additional workers. If, on the other hand, the workload at the maintenance shop decreases, and workers are laid off, they may move away from the area

entirely if there is not enough commercial industrial activity available to absorb them temporarily. However, this would probably happen only in the case of an extended layoff. In general, the American labor force has not been notably mobile in reacting to short-term production cycles.

b. A second reason why the depot maintenance shop work force is relatively inflexible is that the size of the labor force for a coming fiscal year is usually determined during the budgetary process and, in most instances, is conditioned by the best available estimates of the shop's prospective workload. Estimates must usually be made long before firm workload figures for the period have been received from the technical service or NMP. The labor ceiling prescribed in the budget is seldom exceeded in actual practice, not only because of restrictions imposed from above, but, more important, because the skilled personnel needed for overhaul

operations are scarce and seldom willing to work on a temporary basis.

c. Finally, all civilians employed in maintenance activities are either classified or wage board civil service employees. As such, they fall under the jurisdiction of strict regulations which control personnel hiring and firing policies to a great extent. These regulations, which are designed to provide the worker with a reasonable degree of job security, often tend to decrease the flexibility of the maintenance shop's labor force. However, Government regulations controlling labor are generally no more restrictive than the job security provisions negotiated by commercial firms and unions in collective bargaining.

d. To offset this innate inflexibility when the maintenance workload exceeds shop capacity, the shop must go on an overtime status; or personnel must be shifted to the shop from other depot divisions, branches, or sections; or a portion of the work must be contracted to commercial overhaul organizations. Even these alternatives are not always suitable. Any use of overtime is conditioned by such factors as the availability of funds, worker efficiency, and so forth. The technical nature of overhaul prevents wholesale movements of employees among depot activities. Contract maintenance sources, which are technically qualified for the work involved, may be unavailable or too far removed from the maintenance shop to be economically usable. The handicaps and problems created by a relatively inflexible labor force will vary inversely with the adequacy and accuracy of production programs and schedules generated at all maintenance command levels — technical service, NMP, depot, and so forth. If the actual workload at a maintenance shop compares favorably with initial estimates and planned production schedules, the shop's production management should have relatively little difficulty in meeting its labor requirements. If crash programs occur, or if initial production schedules bear little resemblance to the actual workload received, serious, often insoluble, difficulties may arise.

e. One factor which may help to compensate for labor force inflexibility is worker annual leaves. If leaves are scheduled during slack

periods of maintenance activity, rather than during peak periods, maximum utilization of the existing labor force may be achieved. Conversely, unscheduled sick leaves can often create production problems, especially in production line operations. In planning for any production operations the factor of unscheduled worker absence must be considered.

97. Production Skills

The type of maintenance shop—field or depot; the nature of the work to be repaired or overhauled; and the form of production process involved—bay shop or line—will largely determine the production skills required to effectively perform the maintenance mission. In a depot shop with a bay shop operation, workers normally will be required to possess more general technical and mechanical skills than will workers in a production line shop where a greater degree of specialization is required. The bay shop worker is not necessarily any less skilled at any one job than the production line worker, but must usually be able to do more than one job. For both layouts, however, it is generally advantageous, if possible, to hire men with production skills in addition to those required by the immediate job. Worker flexibility helps to offset labor force inflexibility and better prepares the maintenance shop as a whole for supporting all types of Army equipment. Such flexibility is particularly needed to meet the current increased emphasis on IROAN type overhaul rather than complete rebuild. In general, maintenance operations require more highly skilled workers than do most manufacturing operations, since like unserviceables seldom entail identical work and production standards for overhaul operations are frequently less adequate than those used in manufacturing operations. In the absence of adequate standards, the maintenance worker, his supervisor, or an inspector must decide, on the basis of personal experience and know-how, whether to repair or replace a particular component. These judgments require relatively high degrees of worker skill. Because these skills are so important, and workers possessing them are so scarce, labor hiring has become one of the most important and difficult tasks faced by maintenance shop management.

98. Worker Training

a. Worker training should be an integral aspect of depot shop operations. In the first place, the depot cannot always hire competent skilled personnel. Second, training of specialized workers in alternate skills increases overall shop efficiency and work force flexibility. Third, when individual workers become more proficient and more flexible, their wage and salary scales increase accordingly; thus workers may be improved.

b. Training at the depot shop level may be conducted by means of formal off-the-job classes and/or by on-the-job instruction and supervision, with individual workers shifted from time to time to observe and work at different skills. When new equipment is introduced, the technical services may contract for manufacturers' factory representatives to train shop personnel to operate and maintain the equipment. Usually, these men spend at least several days at each installation. In other instances, Regional Maintenance Representatives, maintenance technicians, or contract field technicians may be available to help teach workers new

skills and better methods. Primary responsibility for depot training rests with depot supervisory and management personnel.

99. Worker Pay and Incentives

All civilian shop personnel are either classified or wage board civil service employees. In general, civil service employees include supervisory personnel, certain skilled technicians, and various clerical workers. A classified civil service employee is paid according to congressionally prescribed pay scales for the level of proficiency he has reached in his job. Wage board employees generally include most shop workers directly engaged in production operations. They are paid according to wage scales established by a government agency, the Army-Air Force Coordination Wage Board. The wage board surveys each depot maintenance shop's wage scale periodically and compares it with existing commercial rates for similar skills in the immediate area. From this survey, the board may then adjust shop wages upward or downward to make them comparable to the existing local rates.

Section III. PRODUCTION CONTROL

100. General

a. Production layout may be defined as the physical arrangement of men, production operations, and facilities to repair, overhaul, or rebuild an item of equipment. Army maintenance installations commonly employ one or a combination of two basic production layouts: the bay shop (a fixed station layout) the production line layout, and the bench-type layout. Each layout has its advantages and disadvantages; each generates its own problems. In general, the type of production process or layout used at a particular maintenance installation will depend on the following factors:

- (1) The nature of the maintenance shop's workload, i.e., the types and density of items and equipment that it is responsible for processing, and the level of maintenance that it commonly performs—overhaul or rebuild.
- (2) The nature of the production facilities,

i.e., the machine, tools, test equipment, and so forth, necessary to perform such work.

- (3) The size and nature of the available production floor space.
- (4) The size and skills of the maintenance work force.

b. Production lines are primarily used for rebuild operations or overhaul involving high density items. Bay shop techniques are used primarily; however, many bench-type layouts are utilized in the overhaul of electronics end items and components. Field maintenance shops almost always use bay shop or fixed station layouts.

101. Characteristics of a Production Layout

a. Ideally, a production layout should be built around the items to be fabricated, and the building in which production is to take place should be built around the layout, thus arriving

at a physical arrangement that is completely functional. However, such an arrangement can seldom, if ever, be achieved at an Army maintenance facility. In the first place, a depot or field maintenance shop is responsible for overhauling and repairing a variety of items and equipment, and a layout that is efficient for one type of item may be totally inefficient for another. Secondly, the requirements for accelerated mechanization of overhaul facilities which have resulted from the technological advances made in Army equipments have frequently outstripped the modernization capabilities of the Army maintenance system. Compromise solutions to layout problems are the rule rather than the exception. Inadequately augmented disassembly and assembly lines and areas, fabricated shops, and machine tools often fall short of the requirements of an ideal layout. In many cases, layout deficiencies at a maintenance shop are beyond the control of the local command. Erection of a new building is a long, time-consuming process, and at times, buildings formerly used for storage purposes are now used, inefficiently, for maintenance operations. Production processes and facilities have to be spotted where room can be made available. All too often, two or more buildings that accommodate complementary production processes are located at considerable distances from each other, thereby generating inefficient and costly materials flow.

b. Notwithstanding these handicaps, efficient maintenance production can often be achieved through careful planning and meaningful arrangement of in-plant facilities. Well-conceived layouts facilitate motion economy and thereby serve to reduce costs and speed the productive effort. Material movement and backtracking between process points should be minimized to reduce material handling costs. Sufficient in-process storage space should be planned for in the layout. Backup stocks of repair parts and components should be readily accessible to the major overhaul or repair area. Supporting facilities should be located conveniently to reduce the time spent by personnel walking from their work stations to repair points, stock-

rooms, and other destinations. Finally, any layout should be sufficiently flexible so that changeovers to accommodate the uncertain demands of new and different maintenance programs can be made with a minimum amount of confusion and effort.

102. Bay Shop or Fixed Station Layout

Under a straight bay shop or fixed station method of operation, the equipment to be repaired or overhauled remains in one shop location until the work has been completed; the men and facilities necessary to do the work move to the equipment. Under a modified bay shop operation, machines performing the same or similar jobs are grouped together in sections; the equipment to be repaired moves from one section to another at irregular time intervals until the work has been completed. Bay shop layouts are used largely for third and fourth echelon repair. They are employed for fifth echelon overhaul only when there are not enough like unserviceables or production resources to permit the establishment of a production line.

a. *Process Flow Under Bay Shop Layout.* The bottom portion of figure 10 illustrates a modified bay shop operation in which small utility vehicles are being rebuilt.

b. *Advantages and Disadvantages of the Bay Shop Layout.*

- (1) The principal advantage of the bay shop type of operation is its flexibility and adaptability to changing conditions and demands. Bay shop operations generally use a large proportion of portable handtools. The machine tools used are commonly of the general-purpose variety, as well as overhead cranes and material-handling equipment. Accordingly, changeovers from one type of equipment to another may be made expeditiously, since there are few complex setups to tear down or to make, and there is no line to clear before other work can begin.
- (2) Under a bay shop operation, workers

Figure 10. Bay and production line major overhaul process flow.
(Located in back of manual)

tend to become more highly skilled, and therefore more flexible, because they handle a variety of jobs, rather than a single operation or group of similar operations, as would be the case on a production line. However, workers possessing these skills and training are generally in higher wage brackets than are production line workers, a factor which may contribute to higher hourly overhaul costs. Overhaul of a particular equipment in a bay shop is usually more costly than overhaul of the same equipment on a production line, since bay shop operations are generally slower and less efficient. The size of the bay and the characteristics of the equipment involved frequently limit the number of workers who can work on the equipment at any one time, and work on one operation may have to be completed before work on a second can begin. In a production line, on the other hand, many operations on components and parts of an equipment are performed simultaneously.

- (3) Finally, processing work between bay shop operations may consume more time and money than a production line would, and work may tend to pile up in each section because of the separation and lack of productive balance between operations. This, in turn, may generate additional problems in production control.

103. Production Line Layout

a. General. Under a production line overhaul process, like items flow in a definite sequence through a number of specific overhaul stations. The production process begins with disassembly of an equipment and proceeds until complete reassembly has been accomplished, using new or reconditioned assemblies, subassemblies, and components. Each station on the production line performs the same operation(s) on every equipment. The production line layout used in depot overhaul differs from the mass production line processes used in industry for fabricating and assembling new

items in that mechanical conveyor systems which move in-process items at fixed and continuous rates of speed along the production line are seldom, if ever, used. This is so because the overhaul of each unserviceable generally entails slightly different operations.

b. Process Flow Under Production Line Layout. The top portion of figure 10 illustrates a production line operation in which small utility vehicles are being overhauled. For simplicity's sake, only a few of the many operations entailed in the overhaul of a vehicle are illustrated.

c. Advantages and Disadvantages of the Production Line Layout.

- (1) The chief advantage of the production line layout lies in the economy and efficiency with which large quantities of similar or identical unserviceables can be overhauled. Operations on a production line are carefully laid out in advance of production. The repetitive nature of the work at each station tends to increase worker efficiency and, therefore, to decrease the time necessary for each unit to move through the station. Moreover, since workers specialize in one type of operation, less general mechanical skill is required than in a bay shop operation. Accordingly, it may be easier to break in and train new workers, and average wage rates may be lower.
- (2) A second advantage of the production line layout is that it facilitates the handling and control of work in process by eliminating backtracking. If the line functions properly, work does not pile up between stations, and scheduling of work to subsequent stations becomes an automatic process.
- (3) The chief disadvantage of the production line layout is its inflexibility. Setting up a line for overhaul is expensive in terms of both time and costs. A production line generally requires more extensive facilities and machine tools than a bay shop does, and detailed setups are frequently necessary. Setting up a complex line may con-

sume several weeks, and unless the quantity of unserviceables to be rebuilt is substantial, setup and tooling costs incident to production line operations may not be justified. Clearing the line also takes time, since all items must clear the last station on the line before teardown can begin. Although its productive capabilities may be greater than those of a bay shop operation, the production line layout does not adapt itself to conditions where long range production scheduling is ineffective or unfeasible.

- (4) Another disadvantage of the production line lies in the same area: the amount of production scheduling necessary to insure its effective operation. Before production can begin, a detailed Standing Operating Procedure (SOP) must be drawn up, laying out the exact sequence of operations and the per-unit time required for rebuild at each station. The line itself must then be balanced. Basically this complex and detailed procedure consists of assigning the proper number of workers to each station, so that approximately the same number of equipments can be processed at all stations in the same time period, consistent with the planned production schedule.
- (5) A production line may have to be tested with a pilot run to expose any imbalances between stations, improperly located feeder lines, or other potential delay points. Even after production has actually started, it takes some time to achieve maximum results. During production, absenteeism because of bad weather, unscheduled sick leaves, and so forth can create line imbalances unless other workers can immediately be shifted to the line as replacements. Delays in processing components and subassemblies, or inadequate backup stocks of new parts, can also disrupt production. When these situations arise in a bay shop operation, work in the shop can generally be rearranged to compensate

for the bottleneck. In a production line operation such a rearrangement is often impossible.

- (6) Finally, many large, heavy items, such as medium tanks, are difficult to move from station to station on a line when their power plants have been removed. Accordingly, production line techniques may not be appropriate for items like this even though there is a sufficient number of unserviceables and their condition requires complete overhaul.

104. Functioning and Layout of Support Activities

a. In most maintenance shop layouts, repair, reconditioning, reclamation, and replacement of parts, subassemblies, and assemblies are performed at support sections or stations which are removed from the main production line and bay shop overhaul stations or areas. Each production mission requires varying degrees of support operations and different types of support facilities. Considerations of these many diverse operations and of the varying trade skills involved in performing them makes it highly desirable to functionalize support operations according to tooling and process capabilities. In this way, varying demands from several sources can be coordinated, flexibility attained, and more economical operation achieved.

b. Separation of support operations from disassembly and assembly operations is necessary to achieve production efficiency. Without standard time, production line balance could not be achieved.

c. Figure 10 illustrates typical locations for the major support operations involved in vehicle overhaul — Reclamation, Sandblast, Paint, Preparation and Painting, Body and Fender, Upholstery, Electrical, Glass, and Tank and Radiator. Support sections may be either fixed or portable. The Sandblast and Painting facilities are fixed installations that cannot be moved without costly teardown and re-erection. Many machine tools fall into this same category. Other support sections which use portable tools and other equipment may be

moved to accommodate different major items during overhaul.

d. Fixed support sections are generally set up to accommodate more than one line or bay shop operation. The workloads of these sections are balanced out with parts, components, and assemblies which are not needed for current production and which, after repair or reclamation, are returned to stock for subsequent issue.

e. Figure 11 illustrates the layout and process flow of a typical fixed support activity, transmission overhaul. As in the case of a major end item overhaul line, overhaul operations are performed at various stations, or, as in this illustration, benches.

105. Production Control Techniques and Standards

a. *Functions.* Generally, the functions of the production control unit at a depot maintenance activity include the following:

- (1) Interpreting and implementing, if necessary, technical directives, specifications, and so forth, from higher authorities.
- (2) Planning and establishing production operations in accordance with priorities and schedules directed by the chief of the technical service (this responsibility may be delegated to the depot by the technical service).
- (3) Maintaining continued liaison with the inspection office and the supply branch to insure proper coordination and timing in making technical inspections of items to be repaired.
- (4) Preparing parts requirements and production schedules.
- (5) Devising methods and accumulating data for the preparation of statistical reports (excluding the depot operating cost report) in collaboration with the depot management office and the supply section technical staff.
- (6) Preparing such other recurring and special reports as are required.
- (7) Maintaining control records of current shop operations.

- (8) Coordinating activities among all elements of the depot maintenance division in accordance with production schedules.

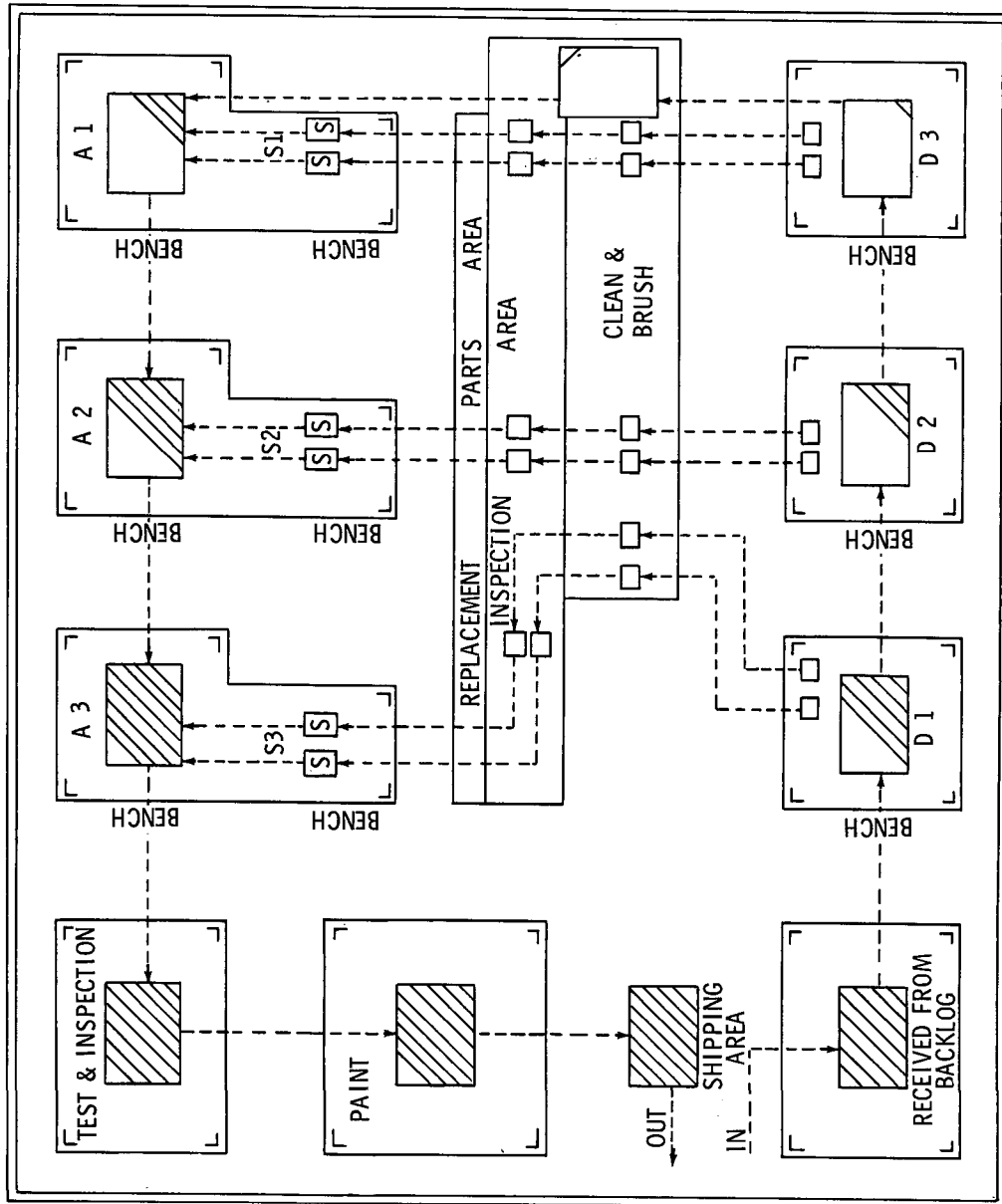
- (9) Analyzing job productivity and developing and recommending action, including improved job layouts and improved equipment repair techniques and procedures which will promote maximum shop productivity consistent with quality standards of repair.

b. *Controls.* Of sole concern herein are the controls used to direct the progress of work in process after it has been scheduled into the maintenance shop for repair or rebuild. The quality control unit at a depot maintenance activity and the inspection office may either be combined into one office, or separated, as the policies of the individual technical service and the exigencies of the maintenance workload require.

c. *Characteristics of a Production Control System.*

- (1) The purpose of a production control system is to provide management with a means of evaluating production progress—in the shop as a whole and by program or job—at any given time. It also highlights areas of difficulty or delay, permitting management to concentrate on these areas, to improve inadequate performance, either actual or threatened. A production control system tells management what should have been done, what has been done, and what is to be done. It serves to illustrate, or control, such factors as labor hours, materials and parts consumption, funds availability, experienced costs, and production time (in calendar days).
- (2) No single financial and production control system is universally applicable to all installations. The design of each control system must depend on the characteristics of the environment in which it must work. An effective control system will consist of two parts: a comprehensive system of pro-

TRANSMISSION OVERHAUL PROCESS FLOW



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Figure 11. Transmission overhaul process flow.

duction standards and a reporting system for using these standards.

106. Production Standards

a. Historical and Statistical Standards.

- (1) An historical standard is the actual time or cost to perform an operation, or to overhaul an unserviceable, which a particular maintenance shop has experienced in the past. An historical standard may be derived from the actual time or costs to overhaul one unserviceable, or, more commonly, it may be an average of the time or costs to overhaul many like unserviceables. Historical standards are frequently inaccurate for scheduling and control purposes since they do not take into account the fact that the conditions of like unserviceables vary. The broader the overhaul experience and the wider the base from which the average is computed, the more accurate the standard will be.
- (2) A statistical standard is similar to an historical standard in that it is derived by averaging actual experienced time or cost figures for performing a certain function. However, a statistical standard disregards atypical operations and costs, that is, any operations and costs which depart significantly from the norm or average, such as rush jobs where workers are not fully efficient, situations in which the unserviceables to be overhauled are in exceptionally good or exceptionally poor condition, situations in which the unavailability of parts makes excessive component repair and fabrication necessary, and so forth. Because atypical operations are excluded, the statistical standard is not a true average—it is more a median than an average—and is generally felt to be more accurate than an historical standard.
- (3) Both historical and statistical standards assume that the actual operations from which they are developed have been efficiently executed. Obviously, if an operation is continually per-

formed inefficiently, any standard developed from measuring that operation will incorporate the inefficiency. To meet this deficiency, the quartile system is sometimes used, under which the most efficient quartile of operations accomplished over a given period is used to establish the standard for subsequent operations. Since standards developed under this system demand a high level of performance, the system is sometimes criticized as being too demanding and too arbitrary.

b. Engineered Standards. Because historical and statistical standards are tied to past performance, and thus may embody production inefficiencies, engineered time standards have been developed based on judgments of what should be done rather than what actually has been done. Simply, an engineered time standard, which is derived either from stopwatch time studies or motion time analyses, represents the normal time in which an average worker should be able to perform a given operation.

- (1) In a stopwatch time study, the job to be evaluated is first broken down into basic elements or timing points. (Fig. 12 shows a typical time study format.) For example, a simple drilling operation might be broken down into the following elements: (a) placing the piece to be drilled on the bench; (b) drilling the hole; and (c) removing the piece from the bench. After this division of the whole operation or cycle, the analyst then observes several complete cycles of the operation, recording with the use of a stopwatch the times taken by the operator for each element. Sometimes the analyst times an operator's actual performance and later times the different elements separately. From these figures, he then computes the average time for each element. Thus, on the basis of his own judgment, the analyst adjusts the particular worker's average time to correlate with the time he thinks a normal worker would take.

TIMESTUDY FORMAT

DESCRIPTION OF JOB _____ NAME _____
 _____ NUMBER _____
 _____ DATE _____

ELE- MENT NO.	ELEMENTS AND TIMING POINTS	TIME IN HUNDREDTHS OF A MINUTE CYCLES										MINUTES		
		1	2	3	4	5	6	7	8	9	10	AVER- AGE		
FROM														
1														
TO														
2														
TO														
3														
TO														
4														
TO														
5														
TO														
6														
TO														
7														
TO														
8														

DETAILS:

(ADDITIONAL SPACE ON OTHER SIDE OF SHEET
 FOR NOTES ON OBSERVED ACTION, SKETCHES,
 CALCULATION OF STANDARD TIME PER PIECE, ETC)

TOTAL ELEMENT TIME ADJUSTED
 FOR WORKER PROFICIENCY --

ALLOWANCES IN MINUTES:

TOTAL ALLOWANCES

STANDARD TIME-MINUTES PER PIECE

STANDARD OUTPUT-PIECES PER HOUR

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Figure 12. Time study format.

- (2) After performing this adjustment, the analyst totals the standard times for each element to develop the standard time for the whole operation. To this time he must then add a prorated share of certain personal and fatigue allowances which the worker will incur during his daily performance, such as relief and cleanup. The result is an engineered standard time for the operation.
- (3) In a motion time analysis study, the job to be analyzed is first broken down into simple body motions, such as lift, move, turn, grasp, and so forth. Generally, a more detailed breakdown is required, and the subsequent computations are more complex for relatively short operations than for longer jobs. Once a job has been broken down, the analyst refers to special tables which contain standard times for each body motion, taking into account the distance the particular body member moved and other factors, such as resistance met or care required. The tables list the results of many motion analysis studies made under varying conditions. For example, it might have been determined that it takes the normal worker .005 minutes, exercising reasonable care, to move his arm 4 inches in depressing a one-pound spring. Any operation, then, requiring this motion under these conditions should be allotted .005 minutes. After recording the standard times for each movement in the operation, the analyst totals them to develop a standard time for the whole operation. Adjustments for worker proficiency are unnecessary in motion analysis studies, since the table factors themselves reflect the motion times of a normal worker. Personal and fatigue allowances must be added in the same manner as in a stopwatch time study.
- (4) As a rule, both stopwatch time studies and motion time analysis studies are best suited to repetitive, relatively simple jobs, such as those which typify most production line opera-

tions. As a job becomes less routine, it usually is less adaptable to engineered time standards. Engineered standards cannot be used at all for some operations. Most important, before any system of engineered standards is installed, a detailed analysis should be made of such factors as production layout, production methods and techniques, production equipment capabilities and utilization, and so forth, to make sure that the operations being timed are themselves as efficient as possible. Time and effort is wasted needlessly when standards are established for an operation that is later changed to effect methods improvements or a revised layout.

- (5) Unlike most commercial manufacturing operations which specialize in one or two items of a line or products, the depot shop overhauls a wide variety of items and equipments to be used throughout the entire shop, standards have to be developed for operation, such as reboring, which are common to the various items that a particular shop overhauls. With the constant change and evolution of Army equipments, the development of adequate standards is a continuing process.
 - (6) Engineered standards have been developed for many activities. They have been prepared for, and are currently used in, some manufacturing arsenals and depot maintenance shops. In this connection AR 1-50 directs the development of "principles for the use, operation, and maintenance of performance analysis of manpower," including engineered standards. As engineered standards become more extensively developed and used, production control of depot maintenance will become more effective. Since they are the most accurate, they are the only meaningful method of determining how long it will, or should, take to do something.
- c. *Component Repair Standards.*
- (1) To complete the job of developing meaningful total work standards for

maintenance operations, standards to determine when to repair or replace parts and components which are removed from unserviceable end items must be established.

- (2) Although economic repair limits for end items are traditional, similar limits or standards for components are seldom used except for major components such as engines. The maintenance shop foreman, or the production worker himself, commonly decides when to repair a given item and when to replace it. The control problems resulting from this situation are many and complex. One depot may be repairing parts which are in relatively poor condition, while another shop may be replacing similar parts in better condition. Even within the same maintenance shop, similar inconsistencies may and do occur. This lack of standards not only can affect the relative costs of labor and of parts for overhaul services, but can also completely negate the efficiency of consumption rates and distort the accuracy of predetermined parts requirements. Conversely, inaccurate parts consumption data can negate the value of meaningful component repair standards. If inaccurate consumption data result in insufficient depot stocks of parts and components to meet end item overhaul requirements, the depot shop may be forced to rebuild unserviceable parts and components which should "economically" be replaced. A lack of component repair standards can also have a detrimental effect on the life expectancy of the overhauled item. Greater emphasis will have to be placed on computing repair standards if control of maintenance operations is to become more effective. Any production control system is basically a comparison of actual progress, or costs, with the estimated time and costs necessary to perform the operation or work involved. To be effective, estimates used for comparison purposes must be accurate, and

the derivation of accurate estimates requires meaningful production standards. Meaningful standards therefore are the core of any production control system.

107. Reporting System

a. General. The reporting systems used by technical services and by maintenance shops within technical services vary significantly. At some of the larger depot maintenance shops, certain production control data are compiled on electronic data processing cards to facilitate summarization and evaluation. In the smaller depot shops, the production control reporting system usually consists of Work Request and Job Order Forms (DA Form 811) (fig. 13), some type of summary listing for these forms, and information gathered by the shop foreman himself. Technically speaking, any record of the conduct of maintenance operations at the local level may be classified as a production control report.

b. Daily Shop Activity Report.

- (1) One basic type of control report used in maintenance operations is the daily shop activity report. Several different technical services, maintenance shops, and echelons of maintenance operations use variations of this type of form, which is usually prepared in the maintenance shop by either the shop office or the shop foreman.
- (2) Typically, one report is prepared daily for each job currently in the shop. The form is broken down into the production stages, operations, or work sections entailed in overhauling the particular item(s) on each job and includes planned or estimated data from the appropriate Work Request and Job Order Form, e.g., total number of units to be overhauled, total man-hours allowed, allocated man-hours per unit, units scheduled per day, and so forth. Actual daily production information (units completed today, total man-hours experienced today, etc.) is also included on the report for comparison with the estimated data. For control purposes, the report also includes actual produc-

DATE 18 Oct 1961		ORGANIZATION MOTOR POOL EXT 2728 Co B, 94th QM Bn (DS)		REFERENCE NUMBER 20891921 B-1		ACCOUNT CODE NUMBER 9040.4300		PRIORITY II RED		JOB ORDER NUMBER 5-2854-R	
TECHNICAL SERVICE ITEM XXXX		QMC		SIG		ENGR		TRANS		RED	
ITEM IDENTIFICATION TRK, 1/4 TON 4x4 M 38 FSN 2320-835-8318 \$2,004.00											
DESCRIPTION OF WORK TO BE PERFORMED Repair or replace engine assy (Valves burned or worn out) (Engine using an excessive amount of oil)											
Repaint Vehicle Completely.											
AUTHOR SYLVESTER JAMES				RECEIVED BY Smith				SIGNATURE Smith			
FILL IN ABOVE AS WORK REQUEST											
ROUTING AND FLOW											
ASSIGN TO		DATE IN		SIGN		DATE OUT		SIGN		FINAL INSPECTION	
A - AUTOMOTIVE		10-20-61		HAW		10-30-61		MP			
I - ARMT & INSTRUMENT											
C - CLOTHING & EQUIPMENT											
E - ELECTRIC											
M - MACHINE											
P - PAINT											
G - GM AND FIRE CONTROL											
S - S&R		11-1-61		HAW		11-1-61		HAW		RMG	
NO HIGHER ECHOLON FOR REPAIRS AND RECLAMATION											
COMPLETION DATA		DATE RECEIVED		ORGN OR WAREHOUSE		RECEIVED BY					
SALVAGE						Lester M. Hayes					
ORGANIZATION						Lester M. Hayes					
WAREHOUSE											
SHIPPED TO											
INSTRUCTIONS FOR EVACUATING EQUIPMENT											
ADDRESS											
DATE RECEIVED											
ESTIMATED MAN-HOURS											
TOTAL LABOR COST		62.30									
TOTAL MATERIAL COST				7.20							
TOTAL JOB COST				69.50							
FILE DATE				14.0							
COMPLETION DATE											

PASSED FINAL INSPECTION
 BY C.G. Russell
 DATE 11-3-61 MILEAGE 10,000

1 July 1961

WORK REQUEST AND JOB ORDER (FM 9-10)

PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE.

DA FORM 811
1 DEC 59

Figure 13. Work Request and Job Order Form (DA Form 811).

tion information to date, i.e., total man-hours experienced to date, man-hours per unit experienced to date, total units completed to date, total man-hours experienced on rejects, and so forth. The production-to-date figures are derived by adding the daily production figures for the date of the report to the production-to-date figures shown on the previous day's report. Review of the report by both shop management and production control personnel will indicate areas requiring investigation of existing or potential bottlenecks.

- (3) For cost and progress control purposes, most maintenance shops supplement the daily shop activity report with additional daily records. Examples of these records include—
- (a) time and distribution reports, which break down the labor force, by workers, to show the distribution of each worker's time among jobs;
 - (b) daily progress reports, which indicate the daily progress of critical jobs in the shop;
 - (c) daily parts consumption reports;
 - (d) daily cost reports; and
 - (e) daily reports on rejects.

These reports are only supplements to the daily shop activity report, which is the basic production control report for maintenance operations.

c. Production Summary Reports. From information contained in the daily shop activity reports, the productions control office and the shop office at most maintenance activities prepare periodic summary reports showing planned estimates and actual production figures for each job order in the shop. These reports may be prepared weekly, bimonthly, or at other regular time periods. Basically, they serve the same purpose for the time period involved that the shop activity report does for a single day. However, many production summary reports are tied in with cost control of maintenance operations in that they include such additional information as the funds authorized for each job order, the parts and

supplies costs experienced to the date of the report, the indirect costs experienced, and so forth. The main purpose of a production summary report is to provide management with an overall indication of production progress and actual or potential production bottlenecks.

d. Production Graphs and Charts. Production graphs and charts that plot actual production progress against planned or scheduled progress are frequently prepared to supplement production summary reports. These graphs and charts are designed to provide management with a visual summary of maintenance operations.

e. Production Difficulty Reports. For production control purposes, most maintenance shops supplement the "standard" reports described above with special reports when production or other difficulties impede, or threaten to impede, scheduled progress. Program shortages lists are frequently used by Stock Control to notify the maintenance shop of stocks of required parts that are exhausted or in short supply. Expedite requests or requisitions may be used to obtain parts from Stock Control for which maintenance shop levels have been exhausted. Various forms of intrashop memoranda are used to draw attention to critical programs or operations that threaten to create production delays. Overtime reports are frequently used to authorize and control the use of overtime in critical production situations. The purpose of any production difficulty report is to facilitate action necessary to correct an impending or actual shortage or production bottleneck.

108. Development of Manpower Requirements

Effective manpower allocation depends largely on adequate performance standards at depots and depot maintenance shops. In the shop, performance standards are helpful in planning individual production runs and in estimating how many men will be needed to handle the total workload. At the technical service level, they are used to determine how much work can be performed by a particular shop and to correlate available manpower with funds requirements. They aid in determining whether quarterly operating personnel requirements are in agreement with the programed

workload. They are helpful in deciding whether interim installation requests for adjustments to personnel authorization should be granted, and they are also used to provide higher authority with performance analysis data on standards and staffing patterns. The more accurate the standards, the more concise can be the planning at all levels.

109. Providing for Tools and Materials

The depot maintenance shop's production schedule must make provision for all special tools, jigs, gages, and fixtures that will be required in overhauling an end item. The types of tools required may be determined in advance by reference to appropriate SB's, TB's, TM's, MWO's, and any previous overhaul experience.

110. Scheduling Utilization of Plant Machinery

Adequate provisions for effective utilization of available plant machinery are also important. Every shop has its potential bottlenecks which threaten to disrupt production quite as effectively as a short supply of repair parts or a lack of funds might. The well drawn production schedule may avoid such delays by providing for the procurement of additional machinery or adopting such expedients as multiple-shift operations of key equipment.

111. Depot Scheduling

a. Once unserviceables have been received at the depot, the process of scheduling them through the overhaul cycle begins. Scheduling at the depot shop level involves any or all of the considerations listed below.

- (1) Breaking down the mutually agreed upon production schedule from the NMP (or technical service) into months, weeks, and days.
- (2) Adding to NMP-scheduled overhaul estimates of the maintenance to be performed on satellited and repair-and-return-to-user equipments. (The methods used to estimate "nonscheduled" maintenance workloads are similar to those used at field maintenance levels.)
- (3) Insuring adequate resources to meet scheduled overhaul requirements—i.e., funds, labor, tools, materials, and

machinery; parts and unserviceable assets.

- (4) Balancing total daily overhaul requirements as to type of unserviceable, production loadings, etc.
- (5) Preparing work requests, job orders, and/or similar documents for the unserviceables to be overhauled.

b. To insure proper utilization of available resources and effective accomplishment of the overhaul mission, a detailed step-by-step description of the general flow of the major item during overhaul, both within and between various shops, is prepared and published either as part of the job order or on a separate SOP (Standing Operating Procedure) sheet. Operational breakdowns for all support activities are also prepared to insure proper coordination with the primary shops.

- (1) On the basis of operational breakdown and routine data, desirable starting and completion times may be computed for each stage of operations by working backward from the final completion data and applying standard times to each stage. The final starting date so reached represents the latest date that work may be begun and still meet the final completion date, barring any unforeseen complications.
- (2) The actual date selected for commencement of overhaul operations will depend on a number of factors: the adequacy of funds, labor, unserviceables, tools, machinery, or materials, as well as the priority of the program itself. In the majority of cases repair parts availability determines the date of commencement of overhaul operations.

c. Production scheduling seldom ceases with the commencement of work. All too often unanticipated events will force revisions in current rebuild operations. Only with the complete teardown of every item do actual parts requirements become known. Constant surveillance must be made of consumption reports so that any trends indicating increased parts requirements may be detected and additional requisitions placed as soon as possible. Other factors which often necessitate revisions in schedules

are unanticipated depletions in the labor supply because of a rise in sick leave; breakdown of key machinery; increases in costs; and, perhaps most common of all, program changes by the

technical service or NMP which result in the advancement of completion dates or assignment of new, higher priority "crash programs" to the installation.

Section IV. INSPECTIONS

112. General

a. The inspection and quality control functions at Army maintenance installations are interrelated and are often performed by one consolidated activity. Whether or not the two functions are separate or consolidated depends largely on the policy of the particular technical service and the workload performed at a given maintenance shop.

b. Commonly, inspection is thought of as the actual examination of a product for defects and for assurance that it complies with established standards. Quality control is the surveillance of production practices, procedures, and actual performance of work to prevent too many defects from occurring. In many industrial concerns, inspection and quality control functions are performed by separate groups with the inspection group reporting either to top company management or directly to the buyer of the product, and the quality control group reporting to production management. In Army maintenance activities the inspection and quality control functions are so highly interrelated as to make a significant differentiation between the too difficult and even unnecessary.

c. Inspection techniques and organizations differ among technical services and among individual maintenance activities within a technical service. Generally, however, inspection personnel are responsible for the following interrelated functions:

- (1) Inspecting unserviceables to determine economic reparability. (At the option of the chief of the technical service, this function may be assigned to the repair or overhaul branches.)
- (2) Inspecting work in process, as required, and completed jobs to determine their acceptability.
- (3) Insuring that all work is performed in accordance with technical standards

and, in case of deviation, deciding whether work is to be accepted or rejected.

- (4) Maintaining staff supervision to make sure that maintenance shop practices, procedures, and performance of work comply with provisions of technical manuals, modification work orders, and similar directives. The main purpose of any inspection activity is to effect the inspection and acceptance of material and equipment in the most economical and expeditious manner consistent with quality assurance.

113. Organization for Inspection

a. At a branch depot, the depot commander is responsible for all inspection of maintenance operations unless other policies have been established by the head of the technical service. At a general depot, the depot commander is generally responsible for organizational and field maintenance inspection conducted at the depot. Technical service serviceability assurance (technical inspection and surveillance) is the responsibility of the general depot commander except when a class II activity has been established. These inspections are considered for accomplishment by class II activities when the commodities involved require unusually complex and highly technical skills and are unusually susceptible to deterioration in storage (AR 780-10). In the interests of achieving maximum utilization of inspection personnel, obtaining better qualified inspectors, eliminating overlapping and duplication, and increasing efficiency and economy, it may be desirable at many depots to centralize all inspection. This includes organizational, field, and depot maintenance inspection; prestorage inspection; storage surveillance inspection; destination acceptance inspection of purchased items; and so forth, in a single inspection activity. When inspection functions are cen-

tralized at a depot, they are generally assigned to an inspection office established in depot headquarters.

b. Centralized inspection activity always reports directly to the installation commander or to the appropriate technical service supply officer, never to the head of a function within the installation, such as the chief of the maintenance shop. Only the use of this procedure can insure impartial and objective judgments based on quality assurance considerations alone. In some technical services, decentralized inspection offices do report directly to the depot maintenance chief.

c. Depending on the size of the maintenance workload, the general types of items and equipments to be repaired or overhauled, and the type of maintenance operation, the inspection force at a maintenance installation may vary from one or two inspectors with general technical skills to a number of inspectors, each skilled in specific areas—e.g., electrical, mechanical, or chemical. For large-volume, relatively complex overhaul operations, inspection teams, consisting of inspection supervisors and individual inspectors located at strategic points throughout the overhaul process, may be used.

114. Inspection Standards

a. The inspection of material and equipment is based on a comparison of actual production with the appropriate inspection standards or specifications which have been developed for the items in question. Inspection standards and specifications are contained in such publications as technical manuals, technical bulletins, supply bulletins, operating manuals, handbooks, drawings, data prepared by the original manufacturer of the equipment to be repaired or overhauled, and other technical instructions issued by the several technical services.

b. Inspection standards deal with the dimensional, visual, weight, performance, and operational characteristics which an item or equipment must have to satisfactorily serve its intended purpose. Commonly, the standards which control the physical characteristics of an item, i.e., dimensions, weight, and so forth, will include maximum and minimum limits of acceptability.

c. Performance specifications set forth the required operational characteristics of an item, such as the output of a motor or a pump, the speed of a vehicle, the lifting ability of a jack, and so forth. Tests to evaluate the performance characteristics of a rebuilt item are often performed under actual operating conditions, as the road testing of a vehicle. In other cases these tests are performed under simulated conditions, as when an engine is tested on a dynamometer test stand.

115. Types of Inspection

Simple inspection is usually performed by an inspector, who examines an item or equipment visually and measures it with rules or gages to determine whether it meets specifications. More detailed inspection might call for the measurement of each component of the item, disassembled, to determine that it is of the correct size. Additional inspection might also be performed to test the hardness, finish, and appearance of the item. The inspector may, however, decide to inspect every item and component being repaired or overhauled, or he may inspect only a certain percentage of the items and components involved. The first type of inspection is referred to as 100 percent inspection; the second is called sampling inspection.

a. *One Hundred Percent Inspection.* With 100 percent inspection, every item which is repaired or overhauled is inspected. Theoretically, the only way that a defective item can be accepted when 100 percent inspection is used is through human error on the part of the inspector. If fatigue is the reason for acceptance of defective units, then the inspection force is usually increased. One hundred percent inspection is commonly used to inspect most end items and major components of end items, and in situations where the number of like items to be repaired or overhauled is not excessive. One hundred percent inspection is the most common type of inspection in maintenance operations; it is used almost exclusively in field maintenance shops and is used widely in depot shops. However, when a large number of items is to be reclaimed or overhauled on a production line basis, 100 percent inspection may prove too costly and time-consuming to be effective. Tests have been developed which prove that 100 percent inspection

tion never removes *all* defective items from a production program. For these reasons, sampling inspection may be more efficient and economical.

b. Sampling Inspection. In sampling inspection, the inspector examines production by one of several possible methods:

- (1) Every tenth or twentieth piece (or some other number in series) is examined as it comes off the overhaul line. All defectives are rejected, and no action is taken with regard to uninspected pieces.
- (2) Every tenth or twentieth piece (or some other number in series) is examined, and when a defective part is found, all pieces between that piece and the next succeeding normally inspected piece are inspected. (There are several variations to this method of sampling production.) If additional defects between the tenth and twentieth piece are found, 100 percent inspection is begun until the cause of the defect is isolated and appropriate remedial action taken.
- (3) Total production for a given time period is divided into lots, and samples from each lot are inspected. If the quality of the samples does not vary significantly from the standard, the entire lot is accepted. If the sample contains significant variations in quality from the standard the lot is rejected. (The compilation of effective sampling plans is a complex statistical technique that differs with types of items to be inspected, past quality experience with the items in question, and so forth.)

c. In-Process and End-Item Inspection. Both of the inspection techniques described in (1) and (2) above may be used to inspect either work in process or completed items. The main purpose of in-process inspection is to reveal defects on work which may be subsequently covered up by later work and which therefore cannot be easily seen during end-item inspec-

tion. In many cases, in-process inspection also serves to reduce overhaul costs by removing defective items from the line before additional and costly operations are performed on them. Generally, in-process inspection is conducted at critical points in the production process: inspection of raw materials before costly machinery operations, inspection of components before assembly, and inspection of complex assembly operations where defects are most likely to occur. End-item inspection is, in effect, acceptance inspection—the determination that a completed item meets established quality standards and therefore can be expected to function properly for a normal operational period.

116. Role of the Inspector in Maintenance Operations

a. As a means of fulfilling the inspection office's responsibility for making sure that all repair and overhaul work at a depot shop (both in-process and completed) conforms to applicable standards, inspection personnel must determine that shop practices and procedures comply with the provisions of pertinent technical data. This responsibility should not be misconstrued to mean that inspectors "supervise" production personnel; rather, they survey production work to uncover practices and procedures which, if uncorrected, will, or may, result in unacceptable material. In addition, inspection personnel are generally responsible for checking the serviceability of tools, test equipment, and other devices being used by production personnel.

b. One of the most important functions of inspection personnel is to cooperate with production personnel in pinpointing production difficulties and eliminating the causes of unsatisfactory work before they impede production. This promotes the understanding that inspectors are trying to further the production process, and are not rejecting work simply because theirs is the prerogative to do so. Because of the organizational position of inspection activities, substantive differences between inspectors and production personnel must be reconciled at a command level.

Section V. SERVICES

117. General

For any production methods, controls, or techniques to be effective, the production resources involved must be fully efficient and operable. Various means are utilized by maintenance management to insure that production resources are fully usable when required.

118. Facilities Repair Support

Repair support activities are those activities at an Army installation that are responsible for maintaining Government property in serv-

iceable condition and, when unserviceable, for repairing and restoring it. All facilities and other types of property will wear out or fail in service eventually. The objectives of any repair support activity are to preclude deterioration and wearout to the greatest extent possible and to insure rapid reactivation to service after breakdowns or failures have occurred. Since proper maintenance and repair support are basic to effective and uninterrupted production operations, they are vital aspects of production management.

CHAPTER 10

PARTS MANAGEMENT

Section I. PARTS FORECASTING

119. General

a. Parts management is a vital aspect of depot shop maintenance management. Its ultimate objective is to insure that adequate quantities of the right types of repair parts are available to meet production requirements at a particular maintenance activity. Proper parts management can mean the difference between efficient and inefficient repair or overhaul operations, economical and costly production, timely and delayed completion of scheduled work, a high degree of equipment operability and an excessive amount of deadlined equipment. This function must be accomplished with a minimum investment in repair parts. Almost all parts are now stock funded and must be paid for with appropriated funds; the return of any excess stock-funded parts for credit is discouraged by regulation (AR 37-65). If the maintenance shop overstocks repair parts, fewer funds will generally be available for other shop programs. Repair parts stocks must be kept at the minimum levels in order to reduce attendant "holding costs"—i.e., the costs to store, inventory, inspect, preserve, maintain records, and dispose of excess and obsolete stocks.

b. Parts forecasting is one of the most important elements of depot shop parts management since the accuracy of parts predeterminations often determines the effectiveness of production scheduling. Whereas other overhaul requirements may be relatively predictable and therefore controllable, forecasting of repair parts requirements without a complete breakdown of the item to be overhauled is difficult at best, and often impossible. The age of an item, the environment in which it was used, its operator, and a number of other variables combine to make the use history of each item

entering the depot maintenance shop unique. As a result, two items of the same make and model may, and often do, have quite different parts requirements. In some cases, parts that are requisitioned for depot maintenance operations are not available in the Army supply system and thus are not procured until they are requisitioned. Often this procurement action requires a lead time of 6 months or more, and depot shop requisitioning of the unstocked parts must be initiated long before any extensive overhaul of equipment is begun. The long lead time required also effectively removes any possibility of relying on supplemental requisitions to rectify mistakes made in originally forecasting the requirements for the parts.

120. Parts Forecasting Processing

a. General. The means of determining the number of parts required for repair of end items depends, quite simply, on the densities of end items to be repaired. If only a few end items require repair, economic maintenance management usually calls for a teardown and inspection of each end item to be repaired with lists of parts required developed from these inspections. Naturally, the repair of these low density end items must await the receipt of the parts. As the densities of end items increase it becomes less and less economic to hold end items in a disassembled state awaiting shipments of parts, therefore the determination of parts required must be based on forecasts. The process of forecasting and the subsequent procurement of parts for the repair of moderate and high density of end items begins with the initiation of a formal Work Request and Job Order (DA Form 811). After initial preparation or review by the Production Control Branch, DA Form 811 is sent to that section of the Depot Maintenance Division which is re-

sponsible for forecasting parts requirements—usually the Parts Predetermination Section. This section computes the kinds and quantities of parts necessary to perform the work, whether it is a relatively small job likely to require only 1 or 2 days or a production line run scheduled to operate for a number of months. The information for these computations is generally taken from detail card files which contain historic data on similar repair operations in the past. Most significant are the consumption rates (sometimes called mortality rates) which indicate the quantity of a part that was used in overhauling a hundred end items.

b. Consumption Rate.

(1) Technical service rate.

- (a) Each technical service has developed and distributed to its depot maintenance shops consumption rates for nearly every major end item and many secondary items for which it is responsible. This rate is based on past experience and gives as a percentage the average number of times in the past that a certain part has been needed for the overhaul of a hundred end items.
- (b) The technical services use consumption rates chiefly to compute future worldwide parts requirements. Each technical service annually forecasts the amount of overhaul and depot shop modification of its equipment that will be necessary during the subsequent fiscal year. It then schedules this workload on a quarterly basis and distributes it to the depot shops. Before each quarter begins, the NICP within the technical service applies to these estimated workload schedules the parts consumption rates it has developed. On this basis, the NICP determines how many new parts must be procured to meet total maintenance needs for the next several quarters. At this time, it refines the quarterly estimates of future parts requirements. Generally, the NICP does not predict

maintenance parts needs for more than four quarters into the future since consumption rates are subject to refinement, and the reported (and forecasted) densities of end items may be increased or decreased during the period. Once the repair parts estimate is completed, the technical service commences necessary procurement so that repair parts will be available in the supply system when they are needed by the maintenance shops.

- (c) Like an historical performance standard, the consumption rate is an average and it is only useful if it represents an adequate number and range of experiences. The age, condition, and parts requirements of any particular unserviceable or group of unserviceables must always vary from the average age, condition, and requirements of all equipment. Some technical services compute separate mortality data for unserviceables in different areas, e.g., Korea, Europe, CONUS.
- (2) *Local rates.* Since the consumption data developed by the technical services reflect average worldwide or theater consumption experience, they may not in all cases, be helpful to the individual maintenance shop parts forecaster. Accordingly, most depot shops have developed their own parts consumption data, based on their own local overhaul experience, to use in conjunction with the technical service rates.
 - (a) Local rates may be of particular usefulness if the shop is overhauling—on a continuing basis—unserviceables which come from a certain specific locale within a theater or area, since the local rate will probably reflect shop parts requirements more accurately than the technical service's.
 - (b) The parts forecaster should never rely on consumption data exclusively in predicting parts needs.

Consumption data are only a starting point for effective forecasting. When using any consumption data, the parts forecaster must always estimate how much the condition of particular unserviceables varies from the average, and he must requisition accordingly. If he knows that equipment is exceptionally old and has had abnormally strenuous treatment, he may order extra parts. Frequently, preshop inspection of the equipment will indicate exceptional parts requirements, and the forecaster should weigh such evidence carefully before he makes his predictions. Because of the particular conditions under which an unserviceable is operated, certain kinds of parts failures may occur almost epidemically. In such cases, an average consumption rate for the defective part will be useless. If a certain part fails unexpectedly and in volume and deadlines many end items much sooner than expected, the consumption data for the other parts belonging to the end items will probably not be valid. When this condition is suspected to exist, a representative sample of the lot of unserviceables may be completely torn down and inspected. This technique is also commonly used for new items for which no mortality data have been developed. In some instances of epidemic parts failures, the technical service may be alerted by failure reports from the field (usually in the form of Unsatisfactory Equipment Reports) and may so inform the depot maintenance shops. But, in all cases, the forecaster must apply his experience and judgment in estimating parts requirements.

(3) *Effects of IROAN.*

- (a) The IROAN technique of maintenance requires a redetermination of parts consumption rates. Under the depot maintenance shop method

of complete teardown and rebuild, many parts were replaced automatically. Under IROAN, these parts will be replaced or repaired only as necessary. In such cases, the consumption rates previously used will no longer be valid. New data will have to be collected, but, until new consumption rates have been established, parts forecasters will have to rely more on their own judgment.

- (b) Even after such rates are established, parts requirements will probably vary more from item to item among unserviceables of the same class of equipment. Although fewer parts normally will be required for each IROAN-repaired equipment, parts replacement will be much more diverse and less standardized. IROAN will reduce parts and labor costs; however, the parts forecaster's problems will be intensified. It will become much more important for him to inspect carefully each lot of unserviceables before he estimates parts requirements.

c. *Reclamation of Parts.*

- (1) After the forecaster has predicted the probable parts needs, he must then estimate how many of these parts can be obtained from reclamation in the shop. Reclamation is the process of restoring to usefulness, condemned, discarded, abandoned, or damaged materiel, or parts or components thereof, by repair, refabrication or renovation, and returning such items to supply channels (AR 320-5). Reclamation is funded out of the depot maintenance budget, Major Overhaul and Maintenance of Materiel (BP 2310—Overhaul Activities).
- (2) The Availability of Source Maintenance and Recoverability Codes (AR 700-18) and the assignment of these codes to all items of maintenance significance will indicate whether an item should be reclaimed. Parts and component repair standards have not

always been available for maintenance shop use, and the decision as to whether or not to reclaim may vary with the person making the decision.

- (3) When a production run of unserviceables is actually in the shop, additional reclamation of components may provide the parts forecaster with some leeway in case new component requirements have been underestimated or are not supplied in time. This will hold true even if accurate component repair standards are developed. While ideally it may not be economical to expend labor and materials in reclaiming a given component, it may be far better to reclaim it in a particular production situation than to hold up work on a lot of

unserviceables for the lack of a new component. Technical service instructions and procedures bearing on reclamation exist and should be used. Cannibalization may also be used as an alternative or emergency source of supply, particularly for low mortality parts and components. Both reclamation and cannibalization require careful consideration by the parts forecaster, since they allow him a safety factor if his new parts predictions prove low. This consideration may reduce the tendency of the forecaster to provide such a safety factor by overestimating new parts requirements, a practice which inflicts serious penalties on the supply and maintenance systems.

Section II. PARTS SUPPLY

121. Initial Actions

a. There are several recourses available to obtain required parts. Depending on established policy, either the depot shop parts forecaster, the depot Stock Control office, the depot Procurement office, or the technical service NICP may direct the appropriate action to obtain required parts if they are not available at the depot. These recourses include—

- (1) obtaining the item from another depot or technical service;
- (2) local purchasing of the item from a commercial manufacturer;
- (3) fabricating the item in the depot machine shop;
- (4) placing the item on back order pending availability;
- (5) cannibalizing the item from CRC 8 items;
- (6) checking substitute stock numbers for availability, and/or
- (7) canceling the order.

b. The availability of parts generally determines when a job order can be released to the appropriate shop and work actually begun. An unanticipated delay of a single key part can disrupt a carefully planned production schedule

quite as effectively as a strike or failure of the end items to arrive.

122. Establishing a Depot Maintenance Reserve and Shop Stock Level

a. In setting policies for delivery of repair parts to the maintenance shop the technical service must take into account the relative priorities of all the differing needs of the depot's customers, including those of the depot shop. Military requirements must be balanced against economy of supply. The policies that suit one technical service best may not satisfy another service's requirements.

b. In many depots a depot maintenance reserve of the parts requested is established whether they are on hand or are to be procured elsewhere. Once established, the depot maintenance reserve is represented by a bookkeeping entry which sets aside for future maintenance shop use the parts presently available or to be received. No physical segregation of these depot stocks is made. Generally, for parts authorized for Army depot stockage, the reserve may not exceed the amount required for the next 90 days of the production run, or for the length of the production run, whichever is shorter. For a 6-month production run, if the

requirements for a certain part authorized for stockage were evenly spread over the entire run, the depot maintenance reserve for that part would remain set for the first 3 months of the run at 50 percent (or 90 days) of the total requirements for the part. After completion of half of the run (or 90 days), the reserve would then be evenly or periodically reduced over the remainder of the run. If, on the same run, the entire quantity of another part were needed during the first 10 days of the run, the initial reserve would represent that total requirement.

c. For parts not authorized for stockage in the Army depot system, the depot maintenance reserve is the quantity required for the entire production run. If certain repair parts are peculiar only to one or a very limited number of end items and have a low consumption rate, they may not be stocked. When the end items are overhauled, the depot must fill the requirements for these parts by commercial procurement. Since it is generally more economical to procure the entire quantity at once, rather than on a piecemeal basis, the reserve for parts unauthorized for stockage is defined as the quantity needed for the entire production run.

d. At some shops, an additional variation has been added. Prior to the beginning of the fiscal year the parts forecaster may determine that certain parts will be used continually through the year in many production runs. He may

then break down the predicted requirements for each such part into quarterly, or 90-day, segments and request that Stock Control establish a constant reserve in this amount for each part. In this case, the reserve is not identified with any particular production run, but is maintained at the requested constant level throughout the year unless actual consumption of the part varies enough from the forecast to warrant revising the reserve (AR 735-15).

e. The existence of a depot maintenance reserve does not guarantee that the depot shop will eventually get all the "reserved" parts. At any time, the parts may be diverted to another customer with higher priority requirements.

f. Even though total parts requirements may not be on hand, the maintenance shop will usually start the production run as scheduled if Stock Control anticipates timely delivery of the parts requirement. When production begins, Stock Control physically delivers to the shop enough parts to support production operations for a limited period—anywhere from 1 to 15 days for various parts according to policy. In establishing depot shop stock levels, several factors are considered, including the priority and size of the production run, available shop storage space, size and cost of parts, and ease and cost of transportation. The levels vary from shop to shop. DA Form 1546 (Request for Issue or Turn-In) is used in this transfer.

Section III. CONTROLLED CANNIBALIZATION AND LOCAL PROCUREMENT OF PARTS

123. General

Parts can be obtained by controlled cannibalization and local procurement.

a. As defined by AR 750-50, controlled cannibalization is "the removal of parts and assemblies from uneconomically reparable or disposable end items, or components thereof, and making them available for reuse." The technical services have established cannibalization points at depots. The cannibalization point will only stockpile those parts or assemblies that are applicable to end items at supported activities. The size of the stockpile will depend on demand experience and good judgment.

b. At depot maintenance shops cannibalization of uneconomical reparable items of equipment will be used as a primary source of supply for low mortality parts and assemblies and to fill such other demands as may be necessary to expedite repair or overhaul of end items of equipment. This will increase maintenance efficiency.

124. Local Procurement

a. Local procurement is another means by which the parts forecaster can obtain necessary parts. The depot procurement office generally has responsibility for all local procurement. The depot procurement office may often dele-

gate authority to the depot shop to purchase certain low value items from local commercial sources, depending on established policy. In some instances, the technical services publish lists of locally procurable items and the maximum prices which may be paid for them.

b. If a shop makes frequent local purchases, it commonly uses either charge accounts or an imprest fund as a financing method (APP 3-650). Under the first method, the depot contracting officer negotiates and places charge accounts with various local parts suppliers. He then designates a shop ordering officer who is responsible for making all necessary local purchases against the charge accounts. Generally, the vendor bills the depot once a month. Over a period of time, the contracting officer is expected to distribute the charge accounts equitably among the different local merchants.

c. Like the charge account system, the use of an imprest fund bypasses the requisitioning

and accounting procedures which are required for individual purchase orders and contracts. Under this method, which operates like a petty cash fund, a fixed sum of cash is given to the shop officer to use in making any necessary local purchases. The imprest fund is reimbursed from installation funds, either periodically or when all cash has been spent. The imprest fund cash, plus the sum of all purchase vouchers used, must always equal the fixed sum of cash with which the fund was established.

d. Under the imprest fund method of local procurement, the depot shop probably has greater freedom to "shop around" for lowest prices than under the charge account method. If local purchases are made quite frequently, however, the accounting required for an imprest fund may become cumbersome. The advantage of the charge account method is that it shifts a large portion of the accounting burden to the supplier.

CHAPTER 11

CONTROLLING THE COST OF DEPOT MAINTENANCE OPERATIONS

Section I. MANAGEMENT OF FUNDS

125. Economy

The prime responsibility of a depot shop manager is to insure that maintenance work of acceptable quality is completed on schedule. Great stress is placed on economy. It is equally important that maintenance operations be performed at the lowest possible cost. Restrictions on funds usage and considerations of economy pervade maintenance operations at all echelons. In the depot shop, allocated funds determine how many personnel may be employed and how many repair parts can be purchased to support workload requirements. When insufficient funds are available for these purposes, the shop cannot meet its production schedules. Accordingly, the shop manager is almost continually faced with the problem of satisfying military requirements within the austere framework of programs and budgets.

126. Cost Accounting

a. In Army maintenance operations, a depot shop manager can use his cash resources or funds wisely only if he knows the costs of operating his shop. At the depot level, appropriation accounting does not provide such information. It records when cash resources were spent, but it does not record actual usage dates for the labor, supplies, or services for which the costs were incurred. Stated another way, funds may be spent for certain resources during one accounting period, while the costs of using those resources either have already been incurred during an earlier accounting period or may be incurred during a later period. If a manager is to control the use of limited resources effectively, he must know the price of the resources as well as when and where they are used.

b. To fill this latter need, comprehensive cost accounting systems have been installed at all

depots. Under these systems, the costs of all labor, supplies, and services used by the several depot activities during the particular accounting are recorded. For the depot shop all direct and indirect costs of operating the shop are collected and recorded under various account titles. At the end of the period, a summary operating statement of the costs incurred by the shop is drawn up and disseminated. Often the accounting office also may collect, record, and report shop costs by individual job orders. For control purposes, these actual job order costs, as well as the total costs reported on the shop's operating statement, are compared with budgeted or expected costs. Careful analysis of these costs may reveal ways of improving efficiency. At the end of the fiscal year, the operating statements for all accounting periods in the fiscal year may be used, with certain adjustments, to forecast appropriated fund requirements.

c. A standard cost system normally is an integral part of the depot's cost accounting structure. Standard costs are predetermined costs that are used by management as a basis of measurement. They are established by a process of scientific fact-finding, based upon past experience and controlled experiment. Predetermined costs that are based purely on past experience and/or personal opinion are known as estimated costs.

- (1) A standard cost consists of a standard quantity multiplied by the standard price of the quantity. Standard time quantity (X) multiplied by the standard wage rate (Y) = standard direct labor cost. Standard direct material and standard overhead costs are measured in essentially the same way.
- (2) Under a standard cost system, certain

transactions are estimated and/or recorded at standard costs. Actual costs are compared with standard costs to learn the amount of, and the reasons for, any difference between actuals and standards. Such differences are known as variances; analysis of the

causes of these differences is known as the analysis of variances. Variances may be expressed in absolute or relative numbers; and they may be measured at any level of depot operations to determine cause and to fix responsibility.

Section II. DEFINITION AND ALLOCATION OF COSTS

127. General

Under any depot cost accounting system, the depot comptroller's office collects and records all depot operating costs during each accounting period and at the end of the period, charges each depot activity with the costs it incurred. For the depot shop, the costs so charged are separated into three general categories: direct labor, direct materials, and overhead. Overhead may be additionally broken down as direct or indirect overhead. Under the direct labor and direct materials categories are included all labor and materials costs that are directly expended on a particular production job (e.g., production workers' wages or repair parts used on the job). Under the direct overhead category are included the costs of all overhead services that have been directly incurred by the maintenance activity (e.g., the shop supervisor's salary or the cost of heating the maintenance shop building). Under the indirect overhead category are included the cost of all overhead services that indirectly support the maintenance activity (e.g., depot administration costs).

a. Direct Costs. Direct costs normally constitute the largest part of the total cost of an item of work. They include most of the labor, parts, materials, supplies, and contractual services consumed in processing a given item or group of items of equipment. Direct costs therefore fluctuate in close proportion to the volume of maintenance operations. A reduction in maintenance workload should produce a corresponding reduction in direct labor man-hours and dollars. The correlation will not be complete since Civil Service requirements introduce a certain necessary inelasticity into the system. Likewise, direct overhead often will not show a complete correlation with volume since many

direct overhead costs, such as the salaries of trained supervisors normally will not be reduced merely because a dip in production takes place. Direct costs incurred in maintenance operations are usually collected on a job order basis. In depot maintenance, job orders often cover a quantity of items, such as 50 jeeps or 100 pumps. Under these circumstances the actual direct cost for each item cannot be known, but the average direct cost per unit will be sufficient for all control purposes except the problem of economic reparability. The category of direct costs includes direct labor costs, direct material costs, direct contractual service costs, and direct overhead.

(1) *Direct labor costs.*

(a) *Definition of labor.*

1. The term "labor" as an element of cost includes all costs incurred for personal services, regardless of whether these services are rendered by civilian or military personnel. Military prisoner labor is considered as military labor.
2. Cost of labor represents total compensation, including shift differentials and overtime, and is computed prior to payroll deductions of any kind. On the other hand, leave accrued by direct labor personnel is an element of direct overhead cost rather than direct labor costs. Other types of fringe benefits, such as the Government's share of retirement and disability benefits and the cost of personal injury compensation paid to employees, are currently not included as a part of depot maintenance cost, direct or indirect. These payments are handled by other gov-

ernmental agencies and do not enter the books of the military services at all.

(b) *Costing procedures.*

1. The source documents for collecting and recording labor effort are in most instances either the foreman's daily activity sheet or individual time cards, both of which report each individual's man-hours of labor by cost code or job order number to be charged. After reconciliation with attendance records, the man-hour information is forwarded to the cost accounting section where total man-hours by cost codes or job order numbers are costed out.
2. In costing out total man-hours, either actual or average departmental rates may be applied; this will depend upon circumstances particularly the size of the shop and the work force involved. In determining direct labor costs in a small shop, the best formula may be to use the actual wages of each worker involved. On the other hand, accounting procedures used in small shops often do not accurately reflect actual hours worked or to be worked by one specific worker on a specific job order. This is particularly true when the composition of working groups may change daily because of operating conditions. In such instances, an average hourly wage may be better employed, even though it will mean that direct labor costs allocated to job orders may vary slightly from actual payroll costs. On the other hand, if a job does not call for any skilled or highly technical operation, an average wage rate that is weighted by the wages of highly skilled personnel may be unfair in pricing the work in question.

(2) *Direct supplies cost.*

(a) *Definition of supplies.*

1. *Consumable supplies.* Those sup-

plies designated as expendable supplies by chiefs of technical services which have a value of less than \$100 and which lose their identity upon issue.

2. *Nonconsumable supplies.* Those supplies designated as nonexpendable supplies by chiefs of technical services and which have a value of \$100 or more and which do not lose their separate identity upon issue.

(b) *Costing procedures.* Consumable supplies are considered to be a cost at the time of issue of the supply document from the accountable supply office to the Single Service Supply Center (SSSC), or to the consuming organization at the standard price prescribed by Financial Inventory and Stock Fund Accounting. Nonexpendable supplies classified as consumable supplies are costed on the same basis as consumable supplies. Nonconsumable supplies and property which have a value of \$100 or more are charged to cost detail accounts at the time of issue. Depreciation is not included as a cost element under ACMS. Supply costs are charged to the consuming activity in the same month in which the technical service accountable property officer records a decrease in the financial inventory journals.

(c) *Accounting procedures.*

1. The key to effective accounting for supplies is the keeping of accurate records by quantity and value for each item acquired, issued to shop personnel, or returned to stock when not used after being issued. Most maintenance shops have the framework for such records but lack the necessary control. Frequently supplies that have been issued in excess of needs are not returned to stock but are allowed to lie around the shop with the intent to use them on some subsequent job if the occasion should

arise. Obviously, this produces improper accounting since these items remain charged to the job to which they were originally issued. To avoid this, the Production Control Chief should insure that shop personnel adhere to the imposed ceilings regarding the number of days of supply that may be kept on hand at a given inventory point. Normally, these ceilings range anywhere from 1 to 15 days, depending on factors such as space, the availability and cost of transportation, and the availability and cost of the items.

2. At the point of actual usage, supply control is also necessary to avoid waste through carelessness or through the use of new parts when used parts might be repaired more cheaply. Practically, this is a matter of integrity of the technical people on the job rather than a matter of accounting. However, accounting control can be effective at this point through the careful review of actual supply requirements in the light of standard and estimated requirements.

(3) *Contractual services and other costs.* Other costs often meeting the criteria of direct costs include those incurred for contract labor, traveling expenses, and contractual services, such as the rental of equipment. Employer's share of FICA, retirement, etc., is included in labor costs. The cost of contractual services and other costs normally are recorded at the time the goods or services are received. Exceptions to this procedure are made only where it is determined that the costs incurred in maintaining accruals would not exceed the benefits derived therefrom. Under this exception, costs are recorded either at the time of execution of the contract or upon receipt of the vendor's invoice. Where estimated costs have been recorded, adjustments are made at the time the actual costs are computed, i.e., adjustments relat-

ing to a prior month are reflected in the current month's costs.

(4) *Direct overhead costs.*

(a) Under the Army Command Management System (ACMS) of costing, direct overhead costs are costs incurred within an organizational element which are not directly identifiable with a cost account, but which are applicable to two or more cost accounts. Typical examples are the salaries of nonproduction personnel, and the costs of general housekeeping supplies. Another element of direct overhead is the leave accrued by personnel. Since annual leave normally is taken during the summer months, leave costs are accrued monthly in accordance with a predetermined factor in order to avoid penalizing operations during the summer. At the end of the year, the difference between the amount accrued and the amount paid for leave taken is charged to the operating overhead of the maintenance shop.

(b) Direct overhead or operating overhead costs are accumulated in a suspense account and are distributed at the end of the accounting period to each job upon which work has been performed during the month. The distribution is made proportionally, relating the direct labor hours expended on each specific job to all the hours consumed by maintenance operations.

b. *Support Costs.*

(1) In a commercial enterprise, support costs would be called "administrative overhead." They are the costs that are incurred outside the maintenance area and are thus not directly related to maintenance operations. Support costs may be further broken down into two categories: fixed and indirect. Fixed cost activities are those that historically do not fluctuate materially with changing levels of mission workload. They include activities asso-

ciated with maintenance of the physical plant, administrative assignments, and general overhead technical and security responsibilities. Indirect cost activities are those that normally tend to fluctuate in relation to the mission workload. Internal rail and motor pool services are examples of indirect support costs.

- (2) Under ACMS, the costs incurred in supporting nonoperating facilities, such as supply depots, airfields, and cemeteries, are not to be included in the indirect costs chargeable to the customers. Another cost excluded is that incurred in maintaining standby facilities.

128. Levels of Control

a. The Basis of Effective Reporting.

- (1) To a great degree, the effectiveness of any cost control system lies with its reporting system. If truly meaningful and accurate data are not made available to each level of management engaged in a review of costs, proper cost control is an impossibility. An effective reporting system must provide the information that management personnel at every echelon require to control and direct performance of their missions. The mass of detailed cost and workload information that a maintenance shop generates should be progressively selected at each level to fit the needs of the next higher level. The information that goes up the chain of command should correspond to the guidance that comes down. Each report should be a statement either that the job has been satisfactorily performed or that for specific reasons it has not been completed according to plan.
- (2) To meet these objectives the Army reporting system has incorporated and utilized the principles of pyramidal reporting and management by exception. Pyramidal reporting means that each successively higher echelon receives progressively more summarized

and less detailed data. Under the principle of management by exception, on the other hand, each echelon of maintenance pays particular attention to deviations or variances from the operating program. These deviations might be termed exceptional performance. They pertain to either a deviation in the scope of work or in the budgeted cost of performing the work. Exceptional performance means that the scope or actual cost of the work has deviated from the operating program by more than some acceptable tolerance, usually plus or minus 15 percent. Such a tolerance is a reporting criterion.

b. Levels of Controlling Maintenance Operations.

(1) *The shop foremen and supervisors.*

- (a) In maintenance operations, the first-line foremen and supervisors are the closest to the actual expenditure of operating funds. All economies in operation will stem directly from their efforts to carry out the instructions of their superiors. Similarly operational inefficiency will stem from poor performance or inexperience on the part of foremen and supervisors or from poor planning by superiors. Once costs have been incurred, the opportunity to achieve savings from executed operations is lost. The longer the lag between operations and contract reports, the greater will be the delay in effective action to reduce costs.
- (b) The greatest opportunity for cost savings at the foreman and supervisor level exists in the area of direct labor. A daily report which compares direct labor hours actually consumed with a sound engineered standard or standard coefficient should provide the foreman with ample control over his operations and the necessary information to pinpoint variances and to make timely corrections. Reporting data should be kept simple and uniform

to insure that adequate information is put into the hands of the foreman as soon as possible. This is achieved by providing the foreman with a daily activity report expressed in terms of man-hours. Use of man-hour data obviates the necessity of costing, a time-consuming process, and still provides ample information for day-to-day control. Such information is readily obtainable either from the supervisors' intrashop activity cards or from the employees' time cards. Because of wage differentials, these daily reports must be supplemented by biweekly or monthly cost-of-labor data compiled by job order number from information provided by the Foreman's Daily Activity Reports. If prepared in a timely fashion, these reports provide an adequate and ready means of determining whether variances between actual and programmed costs are attributable to such factors as over- or under-staffing or the inefficient utilization of premium labor.

- (c) Timely parts and material consumption reporting presents a more difficult problem because of the necessity of segregating and pricing out parts consumption data by job order number in order to derive information that is useful as a management tool. The actual accounting and recordkeeping is decentralized and located in the Production Control Office to insure the availability of up-to-date data needed for day-to-day management. Such a system removes the costs attributable to cost accounting from the direct overhead of the maintenance shop and places them in the category of fixed support costs. This provides a more accurate picture of the actual costs of repair or overhaul.
- (d) Although parts and material costs are not as readily controlled as labor costs, the shop foremen and su-

pervisors have ample opportunity to use parts and material cost data for control purposes. This data is essential to insure that economic reparability limits established by the technical services are not exceeded. Equally important, shop foremen and supervisors should carefully analyze such parts data to see that shop personnel have not been using new parts when repair of old parts would have been more economical, or conversely, that old parts have not been repaired when new items would have cost little more.

(2) *The Maintenance Division chief or Program director.*

- (a) The Maintenance Division chief or Program director should delegate responsibility for controlling costs to the personnel at the operating level. When costs within the branches under his command exceed standard or budgeted costs he will be advised of the deviations and the reasons for them. Therefore, his daily reporting requirements for cost data will be reduced to only those areas where variances have occurred. He can summarize these daily variances and accumulate them for the branches under his command to insure that his division does not exceed its budgeted costs.
- (b) Apart from these requirements, monthly statements on the cost of operations should be sufficient. These monthly reports should document expenditures in the area of direct overhead and indicate the percentage relationship between actual costs incurred and the performance budget. On the basis of such information, the Maintenance Division chief or Program director can concentrate on significant occurrences or trends, favorable or unfavorable, and on any current or potential deficiencies and critical problems of operations.

(3) *The Comptroller.*

- (a) The function of the Comptroller may be summarized by a single word — information. Comptrollership is built around the central function of providing significant information, particularly financial data to the Activity or Installation Commander. The Comptroller's duties may be broken down into two quite distinct categories. As part of the Army-wide comptroller system he must first see that the cost and general accounting system provides, on a timely basis, all the information necessary for external monthly and quarterly reporting of workload accomplishment and resources usage, as well as for formal budget control. Secondly, he must be sure that these external reports carry suitable explanations of any deviations beyond allowable tolerances, such as the cause of the deviation, its impact on the total program, and any action taken or required to be taken to bring the program or costs into alignment.
- (b) The Comptroller has the responsibility for foreseeing and providing, to the greatest extent possible, the information that management, and particularly the commanding officer, requires to make internal management decisions. Under his direction, cost and workload reports covering a fixed period, usually a month, are prepared and submitted to the Activity or Installation Commander. These reports, including one for maintenance operations, provide two broad comparisons: actual workload with that programmed and actual costs with those budgeted. In line with the theory of management by exception, the comptroller pays particular attention to variances so that the Activity or Installation Commander may take that action which he feels is warranted. On the basis of information gathered from these reports as

well as from other sources, the comptroller may prepare statistical analyses, often in chart form, comparing current operations and backlogs with previous figures or comparing the percentage of programmed workload remaining with remaining budgeted funds. When variances have occurred, the comptroller prepares statistical data showing the degree of effort required to bring performance within the program during the subsequent reporting period. He may conduct special investigations to gather any information necessary for effective management if this information is not provided by the established reporting system.

(4) *The technical service.*

- (a) Technical service review and analysis of maintenance operations are directed to any significant variances in actual maintenance costs from those budgeted for. The current reports, such as the DA Form 1508, for depot maintenance, and the DA Form 1510, for field maintenance operations, place considerable emphasis on statistical computations of deviations. In turn, the technical services must provide similar information to the Deputy Chief of Staff for Logistics via the DA Forms 1508 and 1508-1.
- (b) Technical service personnel reviewing maintenance costs often use a second type of statistic, the unit cost of items repaired. This figure offers a ready means of comparing current and previous operations at the same installation.
- (c) Unit cost figures may be unreliable. The chief problem in cost accounting for maintenance is the identification of the cost of completed units. Overhaul cannot be scheduled so that all the work on hand is completed by the end of the reporting period. Invariably, there is some uncompleted work at the

end of the quarter, and the cost of this work must be separated from the cost of the work that has been completed.

- (d) A third figure useful to technical service personnel for cost control purposes is the dollar value of items repaired. The immediate and obvi-

ous value of this statistic is in the establishment of maximum expenditure (economic repair) limits. By using this data, coupled with repair and overhaul cost information, the technical services can insure that maintenance personnel are adhering to these expenditure limits.

CHAPTER 12

CONTRACT MAINTENANCE

Section I. ROLE OF CONTRACT MAINTENANCE

129. Scope

Contract maintenance plays a significant role in fulfilling the Army's maintenance mission. It is used in general to the maximum extent practicable, particularly to meet peak loads (in order to avoid hiring and firing); and for non-combat essential equipment. The use of commercial facilities also underwrites the Army's capacity to meet the greater maintenance demands which would result from partial or total mobilization. Since contract maintenance in the Army is generally performed by relatively small firms, it makes an important contribution toward implementing Congressional policy of encouraging small business participation in military procurement programs.

130. Purpose

Effective management of maintenance operations requires an appraisal of the capabilities of depot and commercial shops and the scheduling of workloads to achieve the most efficient use of the productive capacities of each. Various factors must be evaluated in determining how overhaul requirements may best be apportioned between depot and commercial shops. Many problems are encountered in contracting for maintenance sources, such as selecting contractors, pricing overhaul contracts and delivery orders, and administering contracts to make sure that the Army receives fair value for money expended.

Section II. UTILIZATION OF COMMERCIAL MAINTENANCE FACILITIES

131. Policy

a. It is the policy of the Department of the Army to utilize commercial facilities for the maintenance of military materiel to the maximum extent practicable, except field maintenance in support of tactical elements.

b. The Department of the Army develops and retains an in-house depot level maintenance capability for only that mission essential materiel which will require continuing depot level maintenance to sustain operations under emergency or wartime conditions or which will require such depot maintenance in peacetime to insure operational readiness. This policy must not be construed as requiring a complete capacity when materiel is determined mission-essential. Only the minimum capacity necessary to insure a ready and controlled source of technical competence and resources to meet military contingencies will be maintained. Contractual

sources or cross-service agreements are used for the depot maintenance of mission-essential materiel beyond this established minimum capability.

c. Chiefs of technical services determine which of their items shall be designated as mission-essential and the extent of depot level military maintenance capability to be developed and retained to meet minimum requirements for its support.

d. Chiefs of technical services assure an efficient level of operation for that military capacity retained for the depot maintenance support of mission-essential materiel.

e. The Department of the Army maintains a self-sufficient military capability and capacity for the field maintenance support of its tactical elements.

f. Contract maintenance for new equipment is planned well in advance of equipment intro-

duction into the operating inventory in order that there will be sufficient leadtime for the contractor to obtain the required facilities, tooling, test equipment, and maintenance personnel.

g. Contract maintenance is planned and employed in a manner to provide maximum effectiveness under emergency or wartime conditions, particularly with regard to long-term or continuing type maintenance contracts. The policies and guidance for planning with industry for maintenance under emergency conditions are provided by Logistics Directives.

h. Contracts for maintenance reference such work specifications and quality standards as may be required to adequately insure that materiel upon repair and return is fully satisfactory for service.

i. Contract maintenance is not employed when adequate safeguards cannot be effected to protect security information from disclosure in any manner prejudicial to the interests of the United States.

j. Contract maintenance for requirements beyond the established minimum retained capacity is considered practicable only when it is available at a reasonable price, as provided in the Armed Services Procurement Regulation, and when the contract cost would not be disproportionately higher than as computed under the provisions of AR 235-5, compared with the estimated cost of performance of maintenance at existing facilities. When contract maintenance is not considered practicable, cross-service agreements will be negotiated before the requiring department establishes additional in-house capacity.

k. Contract maintenance has its principal applications in the following areas:

- (1) For accomplishment of maintenance requirements which exceed the military capacity retained to support mission-essential materiel.
- (2) For accomplishment of field maintenance requirements in support of non-tactical elements when the military control and performance of such work are not required for military effectiveness, personnel training, or the main-

tenance of an overseas personnel rotation base.

- (3) For field maintenance support of materiel as may be necessary to augment the military capacity, normally on a one-time basis to accomplish a specific task.
- (4) When it is desirable to augment military maintenance capability for an interim period to attain an earlier operational status for new military materiel being introduced.
- (5) For economical quantities of materiel, or when a steady workload of overhaul and modification maintenance can be anticipated.
- (6) When the extent or complexity of modification or modernization work to be accomplished requires the technical qualifications of the original equipment manufacturer.
- (7) When the leadtimes and processes of maintenance by contract would not result in substantially increased cost for procurement of repair parts to fill an enlarged repair cycle pipeline.

132. Availability and Selection of Qualified Contractors

a. In most instances, the volume of maintenance work which may be contracted out by a particular Army maintenance activity is effectively limited by the availability of qualified contractors who possess the facilities and know-how to do the work. Locating and selecting contractors for overhaul is a far more exacting process than the selection of suppliers for procurement of commercial type supplies and materials. The precise scope of the overhaul work that will be required cannot always be predicted before moving unserviceable equipment into the contractor's shop. For this reason, the prospective contractor's integrity, technical skills, and desire to participate in the rebuild program assume importance in maintenance contracting.

b. In addition a number of more specific qualifications must be evaluated in determining a prospective contractor's ability to perform

maintenance services for the Army. These include—

- (1) the company's current financial status;
- (2) the nature of the company's past contractual performance, and existing backlog;
- (3) the adequacy of the firm's workforce, both in numbers and in skills, to perform work for the Army;
- (4) the availability of adequate repair parts stocks and sources for procuring such parts;
- (5) the adequacy of plant facilities and tooling;
- (6) the existence of adequate transportation facilities at or near the shop for shipment of unserviceables;
- (7) provisions for safeguarding Army property, security procedures, etc.
- (8) the location of the contractor's shop in relation to the depot and, in the case of equipment to be repaired or overhauled on a return-to-user basis, to using activities.

c. Much of the technical and financial information which is essential to a meaningful evaluation of a prospective contractor's ability to perform satisfactorily for the Army, may be obtained from such sources as business directories, banks, suppliers, and trade associations. The local office of the Small Business Administration is equipped to furnish pertinent information about small business concerns in the area. Other information may only be obtained through discussions with the prospective contractor and by a physical inspection of his plant and facilities.

133. Army vs. Contract Shop Maintenance

a. In general, the policy of the Department of the Army is that contract maintenance shall be utilized to the maximum practicable extent. Government-owned commercial and industrial type facilities, for example, are not to be used for performing maintenance operations unless they can be justified by—

- (1) utilization for the maintenance of combat-essential equipment;
- (2) the absence of private facilities of

sufficient capacity located within a reasonable distance from the point of demand. (This exception may be particularly applicable in isolated areas, but the possibility of inducing private industry to meet the need must not be ignored.) ;

- (3) the necessity for meeting the military demand at all times without delay, particularly where abnormal or fluctuating military demand makes the use of private sources of operations impracticable;
- (4) the need for maintaining facilities to train personnel (for operation in a zone of action or advance base, or oversea operations where commercial facilities will not be available) when an organized training program specifically requires the use of the facility in question;
- (5) the existence of compromising information which would aid potential or known enemies or which would otherwise be prejudicial to the interests of the United States, if adequate provisions against this contingency can be made only through Government operation;
- (6) the need for a product or service which cannot be obtained from private sources at a reasonable price because of lack of competition or for any other reason; or
- (7) any other criterion which demonstrates that a particular Government operation is in the public interest, when approved by the Secretary of Defense.

b. It may be necessary to maintain a prescribed level of production at a depot in order to sustain the depot's M-day capabilities. This consideration might include not only the retention of a specific quantity of equipment for overhaul, but also a sufficient variety of equipment, to preserve the special skills of depot maintenance personnel.

c. In determining whether a specific overhaul or repair requirement should be accomplished

in the Army shop or by a commercial firm, Army shop management must first appraise the relative capabilities of the two shops. If the scope of work exceeds the capabilities of commercial shops—as in the case of strictly military items for which specialized facilities and skills are commercially unavailable—the equipment obviously must be retained in the Army shop. On the other hand, some equipment may require special know-how or testing facilities possessed only by the original manufacturer, and overhaul in the Army shop would be impractical.

d. The priority assigned to an overhaul program and the difficulty of the work involved are other factors which may affect the determination to use commercial maintenance shops. The nature of the equipment and troop demand may require that the repair be completed within prescribed limits of time without regard for costs or other considerations which normally prevail. Repair or overhaul for return to user is frequently performed by contractors who are located near using activities. This is often done if Army maintenance operations are already scheduled to capacity and would have to be disrupted to accommodate the new work. The time required to reestablish facilities and retool may make it impossible to meet scheduled completion dates, and the accompanying costs may also be a limiting factor. If there is no existing contract against which a delivery order may be written, the administrative time involved in locating a qualified contractor, negotiating and placing a new contract and in supervising the work may preclude the use of commercial maintenance facilities.

e. It should be kept in mind that even if Army maintenance facilities are partially idle, assigning equipments to commercial shops may be justified as being in the military interests of the Army if commercial facilities are thereby kept intact for M-day or crash program requirements.

134. Economy of Contract Maintenance

If none of the factors mentioned above is overriding, the decision as to whether to perform maintenance work in an Army shop or in a contract shop hinges on an evaluation of the

relative costs of the two methods. This consideration involves a twofold appraisal: a comparison of Army shop and contract costs for repairing or overhauling the same or similar equipments and an evaluation of quotations received from contractors, or of hourly service rates, for performing the work.

a. *Analysis of Army Maintenance Costs.*

- (1) Although Army shop costs and contract costs are not susceptible to precise mathematical comparisons, a reasonable determination of the relative costs of each must be made if contract maintenance is to be efficiently and effectively utilized. Department of the Army has prescribed the procedure for determination of these comparative costs in AR 235-5.
- (2) Direct costs for labor should be recorded daily against individual job orders or line items of overhaul. Combining these costs with direct (maintenance shop) overhead costs and indirect semi-variable support costs permits the development of average hourly service rates which are useful for comparison with available commercial rates. Support costs should include all out of pocket costs, e.g., facility maintenance costs, and general administrative expenses. The administrative costs of supervision of contract work by Army shop maintenance and inspection personnel should be included in evaluating contract service rates.
- (3) Careful consideration must be given to certain other factors which might distort a determination of the relative economy of contract maintenance and Army maintenance costs. Transportation costs must be examined carefully, particularly when return-to-user equipment is affected. It is uneconomical to move such equipment into an Army maintenance activity when Army maintenance costs, adjusted for the cost of transportation, would exceed the cost for repairing or overhauling the equipment in a

contract shop at or near the using activity. It is also more economical to have unserviceables which are to be returned to stock repaired or overhauled at contract shops if the equipments are to be moved to a storage point other than the point of overhaul after completion where transportation costs are reduced.

b. Analysis of Contract Maintenance Costs.

To derive a meaningful quotation for an overhaul requirement, a prospective contractor must construct his price from two basic elements of cost: direct labor and overhead, and direct materials. Whether quotations are solicited on a cost reimbursement, time and material or fixed price basis, these costs must be analyzed to make sure that quoted or estimated prices for repair or rebuild are fair and reasonable.

(1) *Direct labor and overhead.*

- (a) The contractor's cost breakdown is necessary to permit a thorough and complete analysis of his direct labor charges. Minimum information needed to make this analysis would include the number and type of productive workers to be employed in performance of the contracts, the composition of a typical overhaul team, the ratio of the labor hours to complete the contract, and the regular hourly rates paid to each type worker. A direct hourly labor rate may be developed from this information. Proposed hourly labor rates may then be compared with rates for similar work currently and previously contracted for by the Government and with rates to commercial customers. The contractor's commercial rates bear close scrutiny; quoted rates are not always for complete overhaul of equipment, since commercial customers usually require only specific overhaul repairs to avoid deadlining their equipment for long periods of time. Such repairs normally carry a higher hourly service charge because the percentage of

time required in more skilled labor classifications is greater per labor hour than generally is the case in complete overhaul of equipment.

- (b) Since commercial service rates include charges for overhead and profit, these elements of cost must also be analyzed. Overhead must be examined for its composition and for the method used in allocating it to the individual contract(s). Overhead generally includes costs of shop supervision, insurance, materials handling, depreciation of tools and equipment, clerical and office expense, and shop operation and maintenance. Section XV, Armed Services Procurement Regulation, establishes principles on the elements of indirect or overhead costs which may be allowed in cost reimbursement type contracts. These expenses should bear a reasonable relationship to the direct costs of performance on the Government contract.
- (c) Profit is the final element for consideration in the analysis of contractual maintenance costs. Since profit provides the contractor with incentive to perform the work in the time and manner prescribed, it cannot be treated arbitrarily. The profit ultimately allowed will depend on many factors as set forth in Section III, ASPR.
- (d) Conclusions as to the economy of contract maintenance costs should not be influenced solely by low hourly service charges. If a contractor's integrity, business reputation, and efficiency offer little assurance that he will be able to accomplish the work within the estimated time required for its repair, a low hourly service charge is meaningless. The services of contractors who have the reputation of consistently meeting production goals will often be more economical for the Army in the long run.

(2) *Materials cost.*

- (a) Normally, all materials required to repair or overhaul Government equipment are furnished by the contractor. However, the Government may and should reserve the right under the contract to supply any items when it is in its interest to do so. Items of stock in long supply may be furnished if savings may be realized over the cost to the contractor to supply similar items. Similarly, when a contractor is unable to obtain required materials, Army-owned items may be furnished in order to prevent delays in completion of the contract.
- (b) When the contractor furnishes materials, the method of pricing is determined by the type of contract under which the materials are supplied. In the case of fixed price contracts, the cost of materials is evaluated only as it affects the overall reasonableness of the contract price. Proposed prices for materials, whether purchased or fabricated by the contractor, should be

compared with established price lists and prices quoted in the open market. If the contractor receives quantity or cash discounts, a proper share of these savings should be passed on to the Army.

- (c) Cost reimbursement type contracts, including time and materials contracts, provide for the reimbursement for materials at cost—that is, the actual costs of the materials to the contractor, clear of any discounts, allowances, commissions, or other credits available to him, plus properly identified freight and transportation charges, if any. If the contractor draws materials from his own stores, the cost to the Government is the cost which the contractor regularly employs in his own business. Fabricated parts are paid for on the basis of direct material expense, since labor utilized in fabrication is reimbursable under the hourly labor service rate. The contract cost should be credited with the value of any resulting scrap.

Section III. MAINTENANCE CONTRACTING

135. Procurement Action

a. After the decision has been made to contract out for specific maintenance work or services and the necessary unserviceable assets have been received, appropriate procurement action is triggered by the preparation and submission of a Purchase Request and Commitment Form (DA Form 14-115) to the Procurement Office. This form, which is prepared by the Accountable Property officer in collaboration with the shop officer, either sets forth or references all pertinent data needed to effect contractual action. These include a description of the work or service to be performed, the quantity and type of equipments involved, delivery requirements, applicable specification, etc. After preparation, the PR&C Form is routed to the Finance and Accounting Office, which must certify the availability of funds for the proposed work. The form is then sent to

the Procurement Office for appropriate procurement action.

b. Upon receipt in the Procurement Office, each PR&C Form is assigned to a contracting officer who is ultimately responsible for conduct of the procurement. In doing so, he must generally perform the following functions:

- (1) Determine the method of procurement—formal advertising vs. negotiation. (See Sections II and III of the Armed Services Procurement Regulation (APSR) and of the Army Procurement Procedures (APP).)
- (2) Where appropriate, justify the use of negotiation as opposed to formal advertising.
- (3) Develop the list of sources or potential supplies for solicitation.
- (4) Select the type of contract.

- (5) Prepare and distribute the solicitation document Invitation for Bids, Request for Proposals, or Request for Quotation, as appropriate—Section XVI, Parts 1 and 2, ASPR).
- (6) Receive, store, open, and evaluate the bids, proposals, or quotations received.
- (7) When appropriate, select the contractor(s) with whom negotiations will be conducted.
- (8) Award the contract.

c. The shop officer normally acts as a technical advisor to the contracting officer throughout the contracting process. He might be asked to inspect and advise as to the contractor's competency and the fairness of his proposed price for performing the required work. After a definitive contract for the work has been awarded, the shop officer will keep the contracting officer informed of the contractor's progress under the contract. Upon completion, he will conduct the acceptance inspection of the work.

136. Types of Contracts Used to Obtain Maintenance Services

The significance of the various types of contracts used to obtain contract maintenance services lies in the fact that they provide alternative bases upon which a contractor may be reimbursed for his services. Actual selection of the contract type in maintenance contracting is determined by the degree of specificity which the Government and the contractor can attach to their respective obligations. To the extent that the scope of work may be clearly defined and the cost of repair estimated with reasonable certainty, a definite or fixed price may be established for the work to be accomplished. As a rule it is not possible to determine in advance of performance exactly what work will be required to restore equipment to a serviceable condition. The condition of individual unserviceables normally will vary, so that a fixed price for one unit would not necessarily be a fair price for another. Accordingly, reimbursement by the contractor for the costs of performance, together with a fair profit for his services, is the more commonly accepted basis upon which maintenance contracting is accomplished.

137. Fixed Price Contracts

a. The straight fixed price contract provides a set reimbursement to the contractor for his services and the materials he furnishes. The difference between his costs and his reimbursement represents his profit (or loss). The fixed price contract places maximum risk on the contractor and encourages his efficiency. The costs to administer it are low, but it lacks flexibility, and it is inappropriate if job specifications are indefinite as is common in maintenance work. If the contractor cannot determine exactly the extent of the work required, he may inflate a fixed price bid to cover contingencies which may arise. The contract may contain an escalation clause which permits adjustment of the fixed price because of changes in materials prices or direct labor rates. This transfers part of the contractual risk to the Government. If the contractor's costs should vary considerably from his estimate for other reasons, he is not protected. Neither straight fixed price contracts nor those having escalation clauses are extensively used in maintenance contracting.

b. Sometimes, to meet such difficulties, a fixed price contract may be split into two parts. Initially, a fixed price may be set for disassembly, cleaning, and a thorough inspection of the equipment and parts by the contractor. After this work is done, an additional fixed sum may then be negotiated for any necessary repair or overhaul of the equipment. This method is limited to relatively small repair or overhaul jobs, since, if a contractor should decide not to do the second phase of the work, the costs of reassembling, packing, and shipping a large number of unserviceables to a second contractor might be prohibitively expensive.

c. In other cases, fixed price contracts may contain a Price Redetermination Clause (APP 3-403.3). First, a tentative contract price, exclusive of contingencies, is set. After delivery of a portion of the repaired equipment, or at the end of the contract, this price may be re-determined up or down by negotiation on the basis of experienced costs. Redetermination protects both the Government and the contractor where job specifications are so indefinite that costs cannot be estimated exactly. It

is inappropriate for contracts of small value or small probable contingency charges since the administrative costs do not justify the possible savings. Also, a contractor's accounting system may not always be sufficiently adequate to provide the cost information necessary for re-determination.

138. Cost Reimbursement Type Contracts

a. Under a cost reimbursement type contract, the contractor is reimbursed for his costs, as defined in the contract and in Section XV, ASPR, and is usually paid an additional fee, or profit, for his services. Under this contract, the contractor must accurately record and segregate the costs of Government work from those of commercial work; payment is made only after the Army Audit Agency audits the contractor's records. Since the contractor has little initiative to keep his costs to a minimum, close supervision of his performance may be necessary to prevent unnecessary expenditures.

b. A cost reimbursement type maintenance contract is appropriate where production experience and cost data are lacking. The contract must be large enough, however, to justify the increased administrative and supervisory costs to the Government.

139. Time and Materials Contract

a. In a typical time and materials contract, the contractor agrees to provide certain services at an hourly service rate which includes direct labor, overhead, and profit. He supplies materials at cost. Under this type of contract the contractor agrees to repair certain equipment as needed or when called for by the contracting agency. The contract is in effect for a specified period of time (usually 1 year) and contains regulatory provisions as to inspection, payment, property accountability, insurance, etc. The Government places delivery orders on the contractor when the need for the

specified contractual work arises. Each order contains a mutual estimate of the total costs of labor and materials, and a delivery date. Excess costs are avoided by setting a ceiling on the cost of materials or number of direct labor hours for which reimbursement will be made. Cost in excess of this ceiling may be incurred and reimbursed only with the express consent of the contracting officer. During performance and upon completion of the contract, the contractor's books are always open for Government inspection, and final payment is not made until an audit has been conducted.

b. Like the cost-reimbursement type contract, the time and materials contract is used in situations where costs cannot be accurately predetermined and where a fixed price contract is inappropriate. The time and materials contract has been widely used by the Army to procure maintenance services. This has been so for several reasons. First, many maintenance contractors, especially those who operate on a job shop basis, commonly charge for their services according to an hourly service rate. Secondly, it may be argued that the time and materials contract is superior to the cost reimbursement type contract in that the contractor receives no profit or fee on materials, overhead is forecast and absorbed at a rate which is fixed prior to performance and an extensive audit of indirect costs is not required. As set forth in APP 30-104(e), the time and materials contract is the most hazardous and therefore the least preferred of all types of contracts and should be used only in extreme cases where no other available type will suffice to obtain the required supplies or services. When it is used, expensive Army contract administration is required, and the contractor must have a sound accounting system which will permit accurate cost segregation. When a time and materials contract is employed, unusual care should be exerted in the preaward stage to obtain a reliable contractor.

Section IV. ADMINISTRATION OF MAINTENANCE CONTRACTS

140. Obligations of the Contractor

a. Placing a contract that reflects sound business thinking and judgment has no practical significance unless it is performed in strict

accordance with its terms. The efforts of contracting personnel must continue after contract placement to insure that completed items of the prescribed quality are delivered within es-

established delivery schedules. These efforts include—

- (1) insuring that unserviceable equipments, together with any parts or materials which are to be furnished to the contractor, are delivered to his shop in sufficient time to permit orderly and timely production;
- (2) inspecting work in process and completed items to determine that prescribed standards of quality have been met and that performance is satisfactory in other respects and in accordance with the contract terms;
- (3) making prompt payment to the contractor when payment is due.

b. Throughout the performance of the contract, it should be borne in mind that the prime obligation for timely delivery of completed equipments rests with the contractor. The Government exercises only such control as is necessary to make sure that this obligation is met, even though Government assistance may be made available to overcome problems which threaten to impede or halt production.

141. Control of Government Property

a. Since the maintenance contract has reference to specific Government equipment upon which prescribed services are to be performed, it is of fundamental importance that this equipment be delivered to the contractor's shop in sufficient time to permit production in accordance with contractual delivery schedules. The applicable items of equipment together with any parts and materials which the Government is obligated to furnish, marked to permit positive identification and supported with proper shipping documents, should be ready for movement to the contractor in accordance with predetermined schedules. The combined efforts of contracting, supply, and transportation activities are required to accomplish this function effectively and to eliminate delays which may have repercussions later.

b. Once Government property is delivered to a contractor, he is required to exercise the same care and diligence with regard to it that a prudent owner would exercise over his own property. This obligation includes—

- (1) establishing records which at all times accurately identify the property as Government property; and
- (2) caring for and preserving all such property during the life of the contract in accordance with sound industrial practices.

c. After production begins, scrap and salvage will be generated by the repair or overhaul effort. The contract provides that all parts removed from Government equipment, and all scrap from materials which the Government has supplied or for which it has paid—if it possesses appreciable value—will remain Government property. The Government may dispose of such property by returning it to the maintenance installation, permitting the contractor to retain it with an appropriate reduction in the contract price, or authorizing its sale by the contractor with the proceeds applied to the credit of the Government.

142. Inspections

a. In the narrower sense of the word, inspection by the Government involves the test and evaluation of materials and workmanship for conformance to prescribed quality standards. The purpose, scope, and techniques of contract inspection do not differ from inspection performed in depot maintenance shops. Contractual provisions generally specify that all material and workmanship shall be subject to inspection and test at all times and places during the repair or overhaul process. This inspection may take place during performance or upon completion of the contract and may consist of preliminary or final inspection. The Government may reject any articles that are found to be defective in material or workmanship and may require their correction. If the contractor fails to replace these articles or make corrections promptly, the costs of replacement or correction by the Government may be charged to the contractor.

b. Inspection in the broader sense of the work embraces contract administration, as well as inspection to insure conformance with established quality standards. The responsibilities of contract inspectors in this respect include—

- (1) surveying contractual performance to insure that the contractor exercises the prescribed standard of care over Government property in his possession;
- (2) furnishing appropriate progress reports to the depot maintenance activity;
- (3) preparing periodic average productive wage studies by contract or by work order;
- (4) insuring that the contractor furnishes and effectively utilizes facilities and equipment, productive labor in the proper types and ratio of skills, and supervisory personnel as agreed upon during definitization of the contract;
- (5) timely processing of properly executed and duly certified invoices for payment;
- (6) taking appropriate action on any additional repairs found to be necessary and advising the contractor accordingly; and
- (7) notifying the contracting officer of any changes so that he may properly document his files.

c. When repair or overhaul is being performed under a cost reimbursement type contract, a time and materials contract, or a fixed price contract with redetermination provisions, inspectors have further responsibilities which include—

- (1) validating costs charged to the contract or work order through periodic checks of the contractor's books and records;
- (2) determining whether excessive labor or materials costs are being incurred or if recorded charges consistently exceed Army estimates or charges by other contractors for similar work;
- (3) reporting to the depot maintenance activity any indication that repair costs will exceed original estimates; and
- (4) insuring that subcontracted work, if permitted, is purchased at a fair and reasonable price.

d. The inspector should always be available to determine whether individual components or parts of equipment should be repaired or replaced to preclude unnecessary use of new parts.

e. If the inspector uncovers evidence of unsatisfactory performance with regard to the mechanical qualities of repaired equipment or to other terms of the contract, the Army maintenance activity should be promptly notified. When the contractor's ability to perform is seriously questioned and corrective action fails to produce the desired results, all or part of the equipment may be withdrawn from his shop and the work completed elsewhere. If withdrawal results in excess costs to the Government, the additional costs are chargeable to the contractor under the default provisions of the contract.

143. Payment

a. Payment is ordinarily due to the contractor upon completion and acceptance by the Government of all work covered by the contract. Under cost reimbursement type contracts, however, the contractor is reimbursed for his costs on the basis of monthly billings approved by the Army auditor and the contracting officer.

b. The cooperation and good will of contractors depends in large measure on the expeditious processing of invoices and public vouchers for payment. Small contractors in particular require prompt payments in order to meet current operating expenses. The coordinated efforts of many offices and individuals are required at this time. These include—

- (1) the contractor, who submits his invoices properly executed and duly certified in accordance with the instructions contained in the contract;
- (2) the certifying officer, who prepares the public voucher indicating that the contractor has met his contractual obligations and is entitled to payment;
- (3) the Army auditor, who certifies the propriety of the contractor's charges in the case of Cost Reimbursement type contracts;
- (4) the fiscal officer, who authenticates

the funds against which payment is made; and

- (5) the finance officer, who makes payments.

c. Since the contracting officer is directly concerned with maintaining good contractor relations, he should initiate expediting action whenever payment does not take place within established times. He must be especially care-

ful that late payment of invoices does not deprive the Army of the benefits of any time discounts for prompt payment.

144. Shipment

Cooperation and good will of contractors will also depend in large part on the expeditious shipment out of the contractors plant of completed items once they have been inspected and accepted.

PART FOUR
FIELD AND ORGANIZATIONAL MAINTENANCE
CHAPTER 13
BASIC FIELD MAINTENANCE MISSION AND ORGANIZATION

Section 1. DEFINITIONS AND MISSIONS

145. Scope

a. The field armies in CONUS or overseas, whether in combat, peacetime training, or reserve, are greatly dependent for maintenance support upon field maintenance units and facilities. Field maintenance comprises the third and fourth echelons of the five-echelon maintenance system, and consists primarily of repair and/or replacement of equipment beyond the authorized capabilities of organizational maintenance. Field maintenance units may also overhaul or recondition certain assemblies or components.

b. Direct support maintenance consists of inspection, repair, and/or replacement of assemblies and end items on a repair-and-return-to-user basis. It is performed by technical service units, which are organic, assigned, or attached to major commands and act in direct support of using organizations. They may operate under command of armies, divisions, or logistics support commands and ordinarily are organized under a Table of Organization and Equipment (TOE). Direct support units are 100 percent mobile, and perform maintenance services either by dispatching mobile repair teams to the disabled equipment site or by bringing the equipment to the maintenance unit's mobile shops. The mission of direct support units is to provide close maintenance support including repair parts, and technical assistance to using organizations. Using organizations themselves also may perform limited third echelon maintenance when specifically authorized by a TOE, the Maintenance Allocation Chart, or by specific agreement between

the commanders of the direct support unit and the using unit (fig. 14).

c. General support maintenance consists of inspection, major repair, and/or replacement of end items and assemblies on a repair and return to maintenance float or depot stock basis, or in some cases, on a return to user basis. It is performed by—

- (1) general support units, organized under a TOE, that operate primarily on a semimobile shop basis in support of the ZI armies in CONUS or in support of armies in the field;
- (2) fixed field maintenance shops which are not organized under a military TOE and are manned by civilians under military command, operating in CONUS in support of the ZI armies, ARADCOM, or the technical services;
- (3) fixed field maintenance shops, which are non-TOE and are manned by indigenous civilians under military command, operating overseas in support of the communications zone and the field armies.

146. Basic Concepts and Problem Areas

a. While logistic support from depot maintenance affects the overall success of the field army and ZI armies, its influence is less immediate and direct than field maintenance. Field maintenance must be immediately responsive to the supported units' demands, which impose on both elements the need for the closest liaison and cooperation. Field maintenance units supporting tactical units in the field must have a

ARMY SUPPORT UNITS OF A TYPE FIELD ARMY

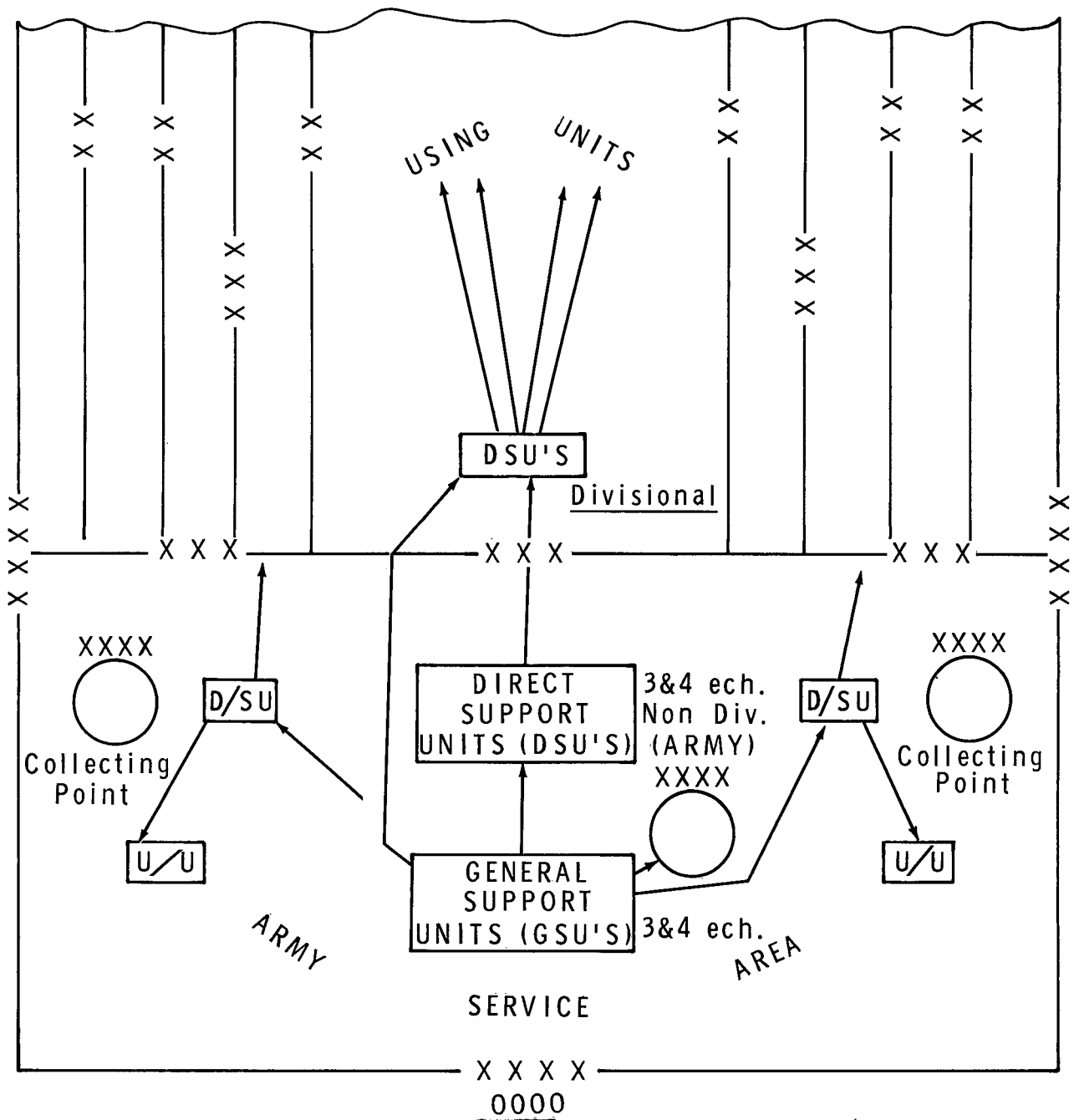


Figure 14. Army support units of a type field army.

high degree of mobility. They must be able to keep pace with the fluid conditions of maneuvers or combat and be prepared to deploy their forces to meet new tactical dispositions. Mobility has been a cardinal precept of direct support in conventional warfare; in nuclear warfare it would impose additional burdens. The high degree of tactical readiness imposed on many units under existing political conditions requires the strictest application of logistics mobility and readiness.

b. The common problems of funds, personnel, and parts which concern all other elements of the maintenance system face Army field maintenance activities both in CONUS and overseas.

- (1) Because of the limits placed on the total Army budget, many funding problems are inherent. Specific funding difficulties may arise as a result of avoidable management failures at field maintenance levels or at parent commands. These difficulties can be overcome or alleviated by more exact

programing, budgeting, and scheduling, or by closer coordination between field maintenance activities and their customer units or cognizant senior commands.

- (2) Personnel fluctuations occur more in TOE units than at civilian-manned shops. For the most part, skill shortages in TOE units are attributable to chronic peacetime Army manpower conditions that affect all units. Many problems can be corrected by more efficient utilization of existing personnel resources.
- (3) Repair parts problems at field maintenance levels include sustaining effective stockage levels, coping with cargo and transportation limitations, and supporting new types of equipment. Many of the problems incurred in achieving balanced repair parts stockage at field maintenance are due to the inherent difficulty of scheduling field maintenance repairs.

Section II. COMMAND AND MANAGEMENT RESPONSIBILITIES AND ORGANIZATION FOR FIELD MAINTENANCE

147. Command Channels

a. Command management over field maintenance is exercised through command channels. Field maintenance shops in CONUS at Class I installations report via the installation commanders to ZI army commanders or the Commanding General, Military District of Washington. Field maintenance shops in CONUS at Class II installations report via their installation commanders to the cognizant chief of the technical service. Class II installations also include depot maintenance shops, many of which have subsidiary field maintenance shops. Overseas, the commanding officers of all field maintenance shops and units report through normal command channels to the respective theater or field army commanders. Command relationships within CONUS are described in AR 10-50 and are pertinent to logistics as well as operations. Maintenance command in CONUS and overseas is further discussed in AR 750-5.

b. In all instances, the technical service that has logistics management cognizance provides technical supervision and assistance over the personnel and equipment involved. The chiefs of the technical services are responsible for Army-wide technical supervision of maintenance and also provide technical assistance to military commanders and other Department of the Army agencies.

c. Field maintenance units in CONUS at both Class I and II activities provide support to designated ZI army, MDW or technical service units under command of the installation. They may also support satellited units such as units under command of the Commanding General, United States Army Air Defense Command (ARADCOM). This support is furnished on a common service basis although the ARADCOM units themselves have no command relation with the particular Class I or II installations. Other Department of the Army activities in CONUS are satellited by direction of Headquarters, Department of the Army on

various field maintenance installations and receive specified maintenance support on a common service basis. Satellization, incidentally, may be made on a geographical rather than army area basis if it is more efficient or economical.

148. TOE Field Maintenance

a. A distinction is made between those field (and organizational) maintenance units which are classified as TOE and those units classified as non-TOE. The TOE for a maintenance unit includes allowable personnel specified by grade and MOS ratings and authorized tools, vehicles, and other equipment.

b. The non-TOE units include certain military units not operating with tactical forces and all civilian-manned Department of the Army units. Most non-TOE units are standardized and governed by Tables of Distribution which indicate authorized personnel spaces and equipment. The fixed field maintenance shops which operate at Class I and II installations in CONUS are civilian-manned TD units. There are also some TD field maintenance units overseas, manned by indigenous civilian labor. Most of these fixed shops perform field maintenance in support of troop units or station activities.

c. As a general rule, TOE direct or general support units will support other TOE military units and may, as required, support certain non-TOE units. (Similarly, a TOE unit may be supported by a non-TOE unit.) A direct support TOE field maintenance unit may receive its support from a TOE general support unit or from a non-TOE fixed field maintenance shop, either in CONUS or overseas. A TOE general support unit serving in CONUS may on occasion be called upon to provide backup support to a non-TOE fixed shop.

149. Command and Organizational Structure of Fixed Field Maintenance Activities at Class I Installations in CONUS

a. Fixed field maintenance activities at Class I installations, are in the chain of command that originates at Headquarters, USCONARC and goes downward through the cognizant ZI army to the post, camp, or station. Staff supervision of field maintenance at USCONARC, ZI army, and installation levels rests with the re-

spective Assistant Chiefs of Staff, G-4. The commander delegates logistic management responsibility to the appropriate technical service staff officer who exercises direct supervision over his service's field maintenance activities as well as over the supply activities of his technical service.

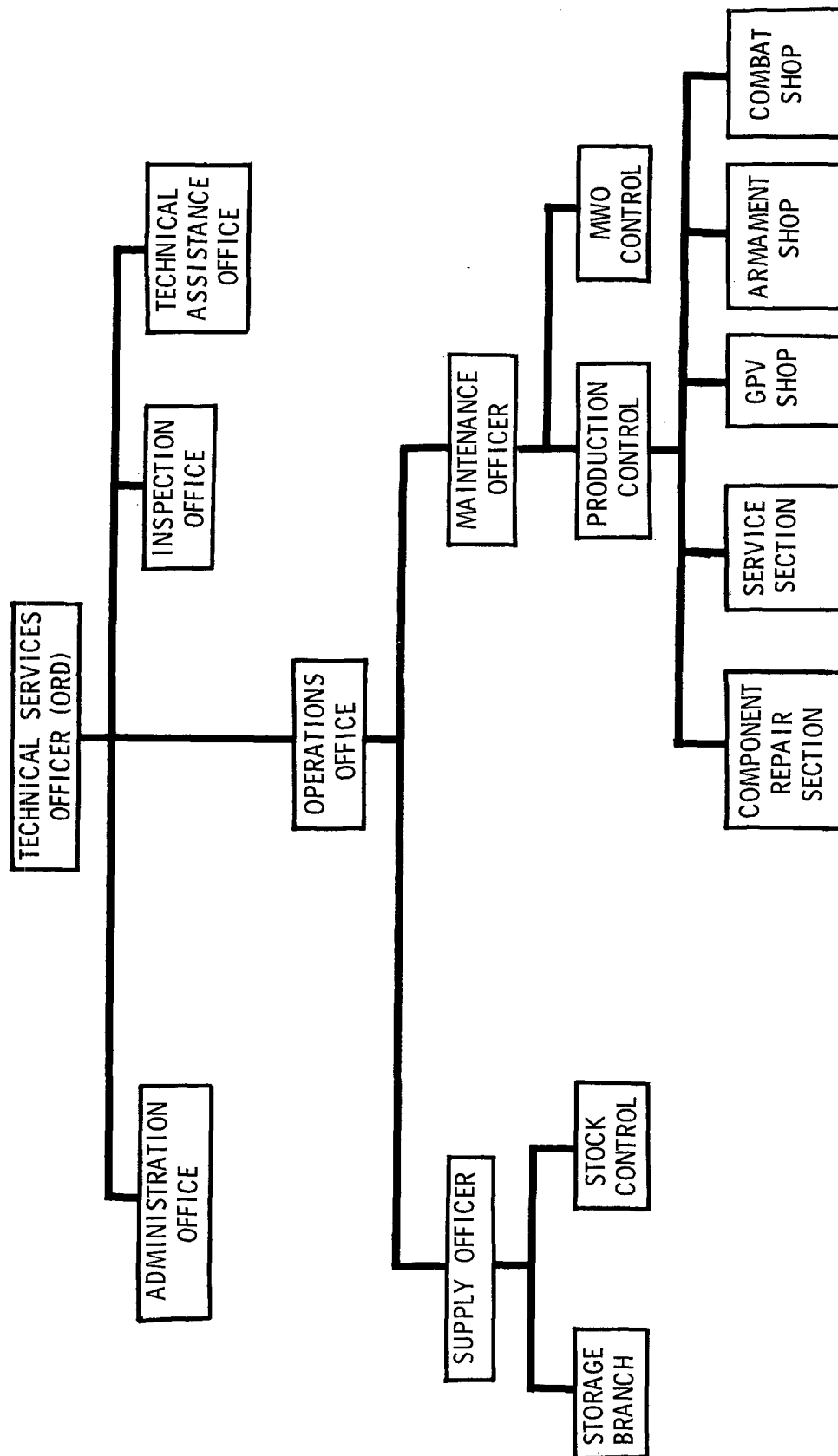
b. The missions and Tables of Distribution of field maintenance activities at Class I installations are established by the ZI army in consonance with USCONARC policy. The standing operating procedures of a particular technical service at such installations are prepared by the responsible technical service officer, subject to approval of the Post Commander, and are in accord with general maintenance procedures set forth in Department of the Army and technical service regulations.

c. In most Class I installations the technical service staff officer supervises the field maintenance shop of his technical service, assisted by a Maintenance Officer and a Supply Officer. The organization structure of the technical service operations at a large but typical Class I installation is shown in figure 15.

150. Command and Organizational Structure of Fixed Field Maintenance Activities at Class II Installations

a. The Class II installation is under the command of the cognizant technical service and receives its mission, policies, funds, and operation orders from the technical service, just as the Class I installation receives its directives and funds from the ZI army or MDW. In both instances, technical guidance is afforded by the cognizant technical services. At a Class II activity the technical service of which the activity is a part usually provides the primary and largest maintenance unit; most of the other technical services will have smaller shops at the installation.

b. Each Class II installation has a command staff which includes an Assistant Chief of Staff, G-4. The G-4 exercises staff supervision over logistics and maintenance activities. The command structure within each technical service at the installation varies in its internal relations, depending upon the nature and scope of the installation's mission. A large organiza-



1 July 1961

Figure 15. Typical overall technical service organization—Class I installation.

tion may have several subordinate shops and the technical service officer may have special staffs for inspection services or technical assistance. A smaller organization may be more consolidated.

c. At many Class II depot activities in the CONUS there are also field maintenance shops that perform organizational and field maintenance on all equipment essential to the operation of the installation, excluding buildings and utilities. Generally, there is a combined field maintenance section (distinct from the depot maintenance activity), which functions under

the depot's Services Officer. This section at most depots is a combination of several shops which maintain the various types of technical service equipment used for internal depot operations. Supplies and repair parts are either locally procured or obtained from the depot supply section. These single or combined maintenance sections are under the command of the depot commander and, through the chain of command, the technical service which controls the depot. Technical guidance is received from the technical services having cognizance over each equipment type involved.

CHAPTER 14

MAINTENANCE OPERATIONS CONDUCTED BY TOE UNITS IN SUPPORT OF THE FIELD ARMIES

Section I. GENERAL

151. Scope and Purpose

Field maintenance operations conducted by mobile or semimobile TOE military units are to be distinguished from those support activities conducted by civilian-manned fixed shops in CONUS or certain oversea areas. In distinguishing these two activities the vital role which fixed shops play in providing field maintenance support to the field armies in CONUS or overseas should not be minimized. However, much field maintenance, especially in theaters of operations, is primarily a military operation in which TOE units play the dominant role. It must be recognized, where reference is made to general support, that in peacetime non-TOE fixed shops often provide this support to using and direct support units in lieu of TOE general support units. This situation is particularly true in CONUS garrisons and to some extent in communications zones. Furthermore, many of the functional organization and shop management practices followed in fixed shops are common to both direct support and general support TOE units.

152. Objectives and Problems

a. Field maintenance TOE units have as their two major objectives the support of other Army units and the conduct of their own training. Within this framework the specific tasks of each maintenance unit vary according to the requirements of their commands and user units. The dual operating-training nature and the

complexity of field maintenance reflect the character of the Army as a whole, whose elements are in different stages of combat readiness and training. In effect, the TOE military units of the Army, be they logistics or combat, must function in a grey area between combat and garrison conditions. While actual combat produces its own acute set of problems, operating in this grey area presents unique difficulties. Much of the current supply austerity stems from peacetime fund shortages and often differs in scope from the type of minimum combat load austerity which will be necessary in combat. There is also a high rate of personnel turnover and severe shortages of maintenance skills. Other problems encountered in the functional aspects of field maintenance include—

- (1) retaining a continuous proper level of personnel, equipment, and repair parts necessary to the effective support of using units;
- (2) sustaining close working relationships with user units, supply units, and other maintenance activities; and
- (3) adapting to new methods of warfare and related maintenance concepts and technologies.

b. Certain difficulties in field maintenance are largely inevitable; others can be corrected or alleviated by clearer identification or by more vigorous application of command management techniques.

Section II. DIRECT SUPPORT UNIT TASKS AND ORGANIZATION

153. Tasks

a. Direct support maintenance is primarily conducted on a service-to-user basis. It encompasses maintenance which is performed on call

either by on-site repairs, direct exchange or replacement, or by repair and return to user. The extent to which these methods of maintenance are employed depends on a number of

factors, including type of equipment, capability of the direct support unit, location of the equipment, combat environment, and transport availability. In both World War II and the Korean War, repair-and-return-to-user was the most common technique of direct support. The trend today is toward more direct exchange or replacement and on-site repairs rather than repair at the shop and return to user. More items are being designed with "pluck-out, plug-in" components and subassemblies which facilitates prompt replacement in the field by direct support teams. More forward mobile maintenance teams are being created which can perform most third-echelon repairs on site, i.e., at the point of breakdown or where the user unit is holding the equipment. Both of these methods ordinarily result in less downtime. They avoid the problems inherent in evacuating heavy pieces of equipment to repair shops.

b. Most direct support units include in their mission the furnishing of all maintenance supply items to the using organizations so that the latter can carry out normal operations and perform required organizational maintenance. Ordinarily, a direct support maintenance unit will only supply parts and tools for organizational maintenance; it will perform second-echelon maintenance for a using unit only in emergencies. All direct support units provide technical assistance to using organizations. This may include conducting on-site maintenance training on new equipment, familiarizing operators or mechanics with new technical publications, instructing unit mechanics on execution of a minor modification to be executed in the field, or assisting a unit in identifying some chronic operating abuse which is causing failures.

c. In combat theaters both direct and general support field maintenance units are equipped with small arms and have the capability of defending themselves against light ground attack.

154. Typical TOE Direct Support Organizations

a. Direct support units fall into two basic types: divisional and nondivisional units.

- (1) *Divisional*. These are service type units usually of battalion size which are organic to a division. These units give direct maintenance and supply support to units of the division.
- (2) *Nondivisional*. These units are organized into companies or cellular type detachments and normally are attached to a technical service maintenance and supply battalion in support of nondivisional units. They may also provide backup support to divisional type maintenance units. These units normally are considered as Army support type units operating in the Army service area and the Communications Zone. They can be both direct support and general support units.

b. *Direct Support Company*. Direct support companies or detachments generally provide mobile direct maintenance and supply support to nondivisional units of the combat zone and/or reinforce divisional units when required. They may be attached to a field army or corps or, in some cases, to the service battalion in a division.

- (1) The repair sections of technical service companies, are usually divided by equipment type.
- (2) The direct support platoons (or mobile repair teams) are especially important elements of direct support companies, since they can provide the forward type of repair which is essential to the continuous combat efficiency of user units. Being 100 percent mobile they can operate in battalion combat areas and are equipped to perform immediate on-site repair or replacement.

Section III. GENERAL SUPPORT TASKS AND ORGANIZATION

155. Basic Tasks

a. Under the current field army organization, general support at field maintenance level is afforded by general support units. These units

are assigned to the army in the field. They operate in the communications zone or in the army service areas within a combat zone. They normally do not support combat units. Their

relationship is ordinarily of a technical-service-to-technical-service rather than a technical-service-to-combat-user nature.

b. General support units normally operate on a repair-and-return-to-stock basis. Their tasks typically include—

- (1) providing backup support to direct support units by performing field maintenance, beyond the capabilities or capacities of the latter;
- (2) assisting direct support units in necessary evacuation and recovery of unserviceables;
- (3) operating collection points for inspection, disassembly, and classification of unserviceables.

These general support units also perform limited reconditioning support on assemblies and subassemblies.

156. Typical Organization

There are no rigid patterns in the organization of general support maintenance units. They are usually organized at company strength, but the command to which they are attached or assigned may vary according to the demands of the theater of operations. Most general support units in CONUS normally are assigned to a technical service battalion organic to an Army. General support units are semi-mobile, possessing from about 50 to 70 percent organic mobility. The bulk of the shop work in the field is performed under canvas or in any available standing shelter.

Section IV. OPERATING POLICIES AND PRACTICES

157. General Procedures

a. The operations of direct and general support units serving with field armies in CONUS and overseas vary. The requirements of the particular army's mission and tasks, the terrain and weather conditions, the types of equipment, and location of the maintenance unit are all factors causing differences in field maintenance operations. The field maintenance problems vary according to conditions prevalent in the area of operation. In all cases, the problems of peacetime, even during maneuvers, will differ in many respects from those of combat.

b. Direct support units are involved in a closer relationship to combat units than are general support units, whose chief customers are the direct support units. The operating conditions for a direct support unit thus stress prompt, close support to using units, to include—

- (1) providing technical assistance to user units with the objective of decreasing failure incidence and improving operation;
- (2) assisting in failure identification;
- (3) performing on-site repairs or replacement by direct exchange;
- (4) evacuating and recovering damaged equipment;

- (5) performing in-shop repairs;
- (6) performing cannibalization, as required;
- (7) providing maintenance supply support to user units; and
- (8) returning repaired items or assemblies to the users or to a maintenance float.

c. General support units back up direct support units rather than users, doing that maintenance which lies beyond the scope of direct support. They repair end items and components and perform limited overhaul of selected assemblies and components at their semimobile shops. Most general support units can readily evacuate heavy equipment from forward areas to the general support shops site. Like direct support units, general support units receive their repair parts and other supply items from supply points or from fixed installations. Upon completing repairs, a general support unit usually returns items to its maintenance float or to depot stocks.

158. Relationship With Using Organizations

a. *The Service Goal.* Mutual understanding and close cooperation at all levels between the using unit and field maintenance units are essential if the latter are to accomplish their mission. The direct support unit must respond promptly to the user's requirements for repair

parts and technical assistance. The commander must imbue all members of his command with the understanding that the only reason for the unit's existence is to give the user the help required to carry out its tactical mission. Such assistance is not limited to answering calls for help. It requires constant liaison to provide the supporting unit with information on the user's care of equipment, anticipated hard usage of equipment, preparation for equipment casualties that will occur in combat, and the effects on equipment that will develop from shortages and exhaustion of personnel. However, the presence of a willing and competent support unit must not be allowed to cause the using unit to become indifferent to, or negligent of, its own maintenance responsibilities. All its personnel must understand that the field maintenance unit cannot do its assigned job if it is burdened with first-and second-echelon work, or work requiring higher echelon repairs that are the outgrowth of poor user maintenance.

b. Identifying Requirements and Instituting Repairs.

- (1) The using unit has primary responsibility for identifying failures and for determining what deficiencies are beyond the capability of organizational maintenance. The cognizant direct support unit has primary responsibility for determining in such cases the extent and type of field maintenance required and the point and time at which this field maintenance will be performed. The specific methods by which these responsibilities are exercised will vary with local environmental and tactical conditions, the type of equipment, and the particular standing operating procedures of the user and supporting units. The initial identification of failure may be made by the operator, and then reported to the organizational mechanic. If the failure is beyond the established capability of organizational maintenance, the direct support unit can either—

- (a) request that the item be brought in for repair or exchange by the using

unit or by the direct support unit's recovery team;

- (b) send out a mobile repair team to perform on-site repairs or replacement; or
 - (c) send out an inspector if there is a question as to repair action required. This does not mean that this decision-making process occurs for each incident of failure. Most types of maintenance deficiencies are repetitious and once a suitable method of repair or evacuation is established for a given type of failure, it usually will be followed as a matter of prescribed routine.
- (2) The direct support company headquarters is responsible for deciding which course of action to follow after receiving a report from the line battalion. In many combat situations the mobile repair teams or direct support platoons are operating in the field, and if they are on the command communications net or in physical contact with the user units, they may receive the failure reports directly. However, even in these cases the mobile repair team ordinarily reports this information to its headquarters before undertaking any extensive repair or evacuation operation. In combat situations, communications among the users, the mobile repair teams, and the parent direct support unit must operate efficiently. It must also be clearly understood what communications are authorized directly between user units and the forward mobile teams and also what authority has been delegated to the mobile teams regarding when, where, and how to make repairs.
- (3) The direct support company headquarters or its forward direct support platoons, when designated, after receiving a report or examining the failed item, will determine whether field maintenance will be performed on site or at the company shops, and whether it will be performed by direct exchange, or by repair and return to

user. Smaller items or major components which break down in the forward company combat zones are replaced on site by direct exchange and the item or component is repaired and returned to stock. During combat, a major piece of equipment, such as a truck, tank, or field radio set, is usually evacuated by the line battalion out of the immediate combat zone. Thus, any "on-site" repair or replacement made by the direct support unit is actually at the site of the battalion's evacuation point rather than at the actual point of failure. This practice, where feasible, is preferred, since it enables the direct support unit's mobile repair teams to operate in relative safety. However, in some cases, a mobile repair team operating in the combat zone may move up to an infantry or armor company's combat area and perform an emergency repair or replacement at, or very close to, the point of equipment breakdown.

- (4) The mobile repair teams are a critical asset and must be used prudently by the direct support unit commander. It is essential that a priority system be established for their employment in order to maximize their utility. Granted that all TOE equipment and units presumably are essential to combat, some, more essential than others. A direct support unit commander, his operations officer, and the direct support platoon leaders must be familiar with the combat criticality of various equipment and of the units which they support, so that during an exercise or combat the highest priority jobs will receive the most prompt service by mobile repair teams. Similarly, a job priority system must be established for repairs which are to be made back at the direct support shops. Priorities may have to be revised during combat to meet changes in the tactical situation; nevertheless, a field maintenance unit which at least commences a combat operation with a basic priority system will be able to fulfill

its support mission far better than a unit which operates on a first-come, first-served basis.

c. Evacuation and Recovery. Evacuation and recovery is largely a field maintenance unit's responsibility. Most large equipment can only be evacuated by a direct support unit which usually has a section manned and equipped for that specific purpose. Furthermore, in combat it is preferable that defective equipment of any size be evacuated by the DSU and not by the user unit. In combat, the personnel of using units should not be diverted from their own unit tasks. Only when absolutely necessary should the using unit assume responsibility for evacuation. The direct support units also will determine whether evacuation to a general support unit is required and, if so, will arrange for the evacuation.

d. Maintenance Exchange Stock. Maintenance exchange stock (maintenance float) is a quantity of major items required and authorized for stockage at field maintenance units and activities to provide replacement for unserviceable items of equipment when repair and return of unserviceable items to the user cannot be accomplished within a specified time. Maintenance floats have assumed increasing importance in field maintenance, especially in direct support operations, because they permit immediate exchange of serviceables for unserviceables and enable a using unit to perform its assigned mission without serious interruption. The use of floats also enables a field maintenance unit to complete repairs back at the shop with less urgency and, in combat, with more freedom from the press of battle. Since floats must allow for repair and turn-around time, they are limited to high density or critical mission items lest they become too costly and burdensome to the logistics system. Maintenance floats are computed by the technical services; information concerning the operation of the float system and authorization of specific items for stockage at direct and general support levels is contained in technical service supply bulletins.

159. Internal TOE Shop Operations

a. General. The operation of a TOE field maintenance shop follows the basic principles

of a fixed shop. The shop practices will vary because of differences in operating environments and in the nature of mobile and semimobile shop versus fixed shops. There is likely to be greater flexibility and informality in TOE shop operations. Scheduling, which is difficult enough to accomplish at fixed shops, is almost impossible at TOE maintenance units. Stability in layout of supply and shop vans is complicated by mobility requirements and site selection problems. The restricted physical nature of direct support unit facilities and, to a lesser extent, general support units also creates a different working environment from that found in fixed shops. In a theater of operation, combat conditions greatly affect TOE maintenance internal shop operations, causing more frequent movements, erratic supply, and disrupted communications with using units and other logistics units. Despite these various unique problems encountered in internal TOE shop operations, the shop practices are reasonably standardized. The vans or tents are arranged where possible in a manner similar to a fixed shop, with provision for shop supply and for bay shop type repair. The vans or tents are usually set up on a functional basis with separate vans or bays set up for specific types of repair. Dispersion must also be a factor in arranging shops.

b. Site Selection and Shop Layout. The selection of a site for and the layout of TOE field maintenance shops depends upon the tactical situation, environmental conditions, the unit's mobility, TOE, and mission and the availability of resources. A direct support unit will move its vans to an area selected by the unit commander (with the concurrence of the cognizant tactical commanders) which will insure optimum service to the user units and protection for the maintenance unit. General support units are also located subject to tactical requirements and usually also take advantage of available local buildings in which shops can be set up. The layout of shops is determined largely by the TOE which establishes the shop sections and the authorized repair equipment. Considerable discretion rests with the unit commander in arranging his vans, tents, or in laying out a building. Generally, the shop office and/or Operations Section is located nearest to the shop or equipment pool area since this is usually

where initial and final inspections are made. The shop supply section should be centrally and conveniently located with respect to the repair sections. A commander should also utilize terrain and dispersion to their best advantage as a protection against conventional and nuclear attack and also against the elements.

c. Scheduling. A TOE field maintenance unit can do little formal scheduling or repairs. Most repairs are made on an on-call, as-needed basis. However, many TOE field maintenance units have endeavored to achieve some form of scheduling wherever possible. By judicious use of visits, regular work contact, and inspections, a field maintenance unit can often anticipate major repairs and do advance scheduling on certain types of items and repair jobs.

d. Inspection and Work Control Performance. Operation of a mobile or semimobile TOE shop follows the basic pattern of fixed shops. Control over repairs is exercised in most cases by an Operations Section of a direct or general support unit or by the chief of each repair section within the unit.

- (1) *Inspection.* Most field maintenance units have trained personnel specifically designated as inspectors who are attached to the Operations Section. They usually perform a thorough initial inspection of items brought into the shop area for repairs to determine the exact nature of the work and repair parts required. Deficiencies of organizational maintenance should also be noted. The earlier on-site inspections usually are made by repairmen attached to mobile teams assisted as necessary by regular inspectors. In process inspection may be made to insure quality or to identify areas needing improvement. Final inspections are regularly performed before a repaired item is returned to the user or to stock.
- (2) *Work control and performance.* The work flow is similar to that in fixed shops except for the physical differences. After inspection, a job order number usually is assigned and the job, with its accompanying Work Re-

quest and Job Order Form (DA Form 811), moves to the various vans or bays for necessary repairs. Control is exercised by the Operations Section, or its equivalent, monitoring the job progress and expediting work. The necessary parts are obtained by the supply section and issued to the repair sections.

- (a) Most TOE shops keep a work flow board showing the location of various job orders with an expected date of completion. Repair section chiefs generally submit a daily report listing job order progress and noting any unusual delinquencies in parts or tools delaying a job.
- (b) To assist the field army in overall

control over field maintenance, the TOE field shops report performance to higher headquarters on the DA Form 1510 (Maintenance Readiness and Field Maintenance Costs) and DA Form 1510-1 (Maintenance Readiness of Representative Critical Equipment). Field army and commanders are concerned about keeping deadlined equipment at an absolute minimum. Excessive deadlines can seriously impair combat readiness of a field army. It is incumbent upon direct support unit commanders to insure expeditious work flow and to notify general support units promptly when backup support is required.

Section V. PERSONNEL AND TRAINING

160. Problem Areas

The growing complexities of military technologies and concepts have magnified the importance of skilled military personnel in both operational and logistics areas. The successful accomplishment of field maintenance support by TOE units continues to depend in great measure upon the availability and proper employment of military technical personnel. The importance of these men, however, is not matched by their numbers. The TOE units of the Army maintenance system, like other military elements of the Army, suffer a chronic shortage of skilled mechanics and repairmen.

161. Personnel

a. The productivity of field maintenance personnel must keep pace with advances in technology and combat techniques. This can be achieved essentially by—

- (1) increasing the reliability of equipment;
- (2) further simplifying maintenance technical requirements on new equipment;
- (3) increasing quantitatively the numbers of skilled maintenance technical personnel;
- (4) improving the skill levels of individuals;

- (5) providing more efficient distribution and employment of available personnel resources.

b. The Army is emphasizing increased reliability and maintainability of new items. Yet despite the success of present efforts and the anticipation of future advances in maintenance engineering, there can be no complacent expectation of maintenance engineers working miracles in the years ahead. All methods of closing the gap between maintenance technical requirements and personnel skills and keeping this gap closed must be exploited.

162. Training

a. *School Training.* The training of field maintenance personnel, both commissioned and enlisted, is primarily a responsibility of the technical services. The technical services operate the service schools, which train officers and enlisted men in their respective military occupational specialties. Extension courses are also provided by the schools for refresher and advanced training in technical skills pertinent to maintenance. Training in maintenance management is afforded combat arms and technical service officers and civilian personnel at the Army Logistics Management Center.

b. *Unit Training.* Much of the training of field maintenance personnel is accomplished

through training exercises and courses conducted by direct and general support units rather than by school or on-the-job training of individuals. Unit training covers a broad range of formal and informal programs. To a large extent, any field maintenance unit in peacetime carrying out its regular mission support activities is simultaneously engaged in unit training. Army Subject Schedules (DA Pam 310-3) and various School Program Instructions are available to the Unit Commander to aid him in unit training.

c. *On-the-Job Training.* The successful operation of most field maintenance units, and the advancement of field maintenance personnel greatly depends upon on-the-job training. Formal school training seldom can completely prepare a technician for his assigned duties. New men must become familiar with the more restricted operating conditions of the field and with tools, machines and test equipment available in the organization. These, in most cases are not the latest models provided in service schools. On-the-job training cannot be conducted on a haphazard basis. This training

should be a specific phased program of appropriate individual instruction. The section chief should be directly responsible for training new men and should prepare a definite training schedule or program of instruction for each MOS space. This schedule should not be an elaborate affair consuming unnecessary administrative time and paper. It should simply be a brief document showing the training objective; the means of training, such as by demonstration or doing; the time allotted; the responsible instructor, and the method of evaluating the results of the training, such as a written or oral quiz or a demonstration by the trainee. The formal phases of the training should be done at a specific hour so as not to interfere with the regular duties of the instructor or the trainee. There is a natural reluctance to run an overly formal, on-the-job training program, and certainly it should not disrupt the unit's operation. A man improperly trained on the job may do serious damage to himself or to his equipment. A man who is well trained in his job is best prepared not only to do good work but to qualify for advancement and further schooling.

CHAPTER 15

FIELD MAINTENANCE SHOP MANAGEMENT

Section I. FIELD MAINTENANCE FIXED SHOP ORGANIZATION

163. General

a. The fixed field maintenance shop closely resembles the depot maintenance shop in its procedures and practices, although it is usually smaller and its operations less complex. Unlike the depot shop, the field shop supports specific using units and, in most cases, returns repaired items of equipment to these units. It does not, except in exceptional instances, return repaired items to stock.

b. Specific details of a particular technical service's shop organization may be found in technical manuals and in individual shop standing operating procedures. Certain basic principles of organization and management are pertinent to any field maintenance shop:

- (1) Each duty must be clearly defined.
- (2) The chain of command and channels of communication must be clearly understood and followed by all personnel.
- (3) Authority and responsibility should be properly delegated.
- (4) Duplication of either authority or responsibility must be avoided.

c. A typical field maintenance TD fixed shop organization at either a Class I or Class II installation is shown in figure 16. In this particular shop both inspection and production control are under the shop chief. In other shops, these functions may be directly under the technical service officer. There is no rigidity if field maintenance organization, and the degree to which various functions are consolidated under one management body varies with the mission and scope of a given post's field maintenance activities. The typical shop shown in figure 16 includes a shop officer, production control office, supply section, inspection office, and several repair sections. The number of repair sections

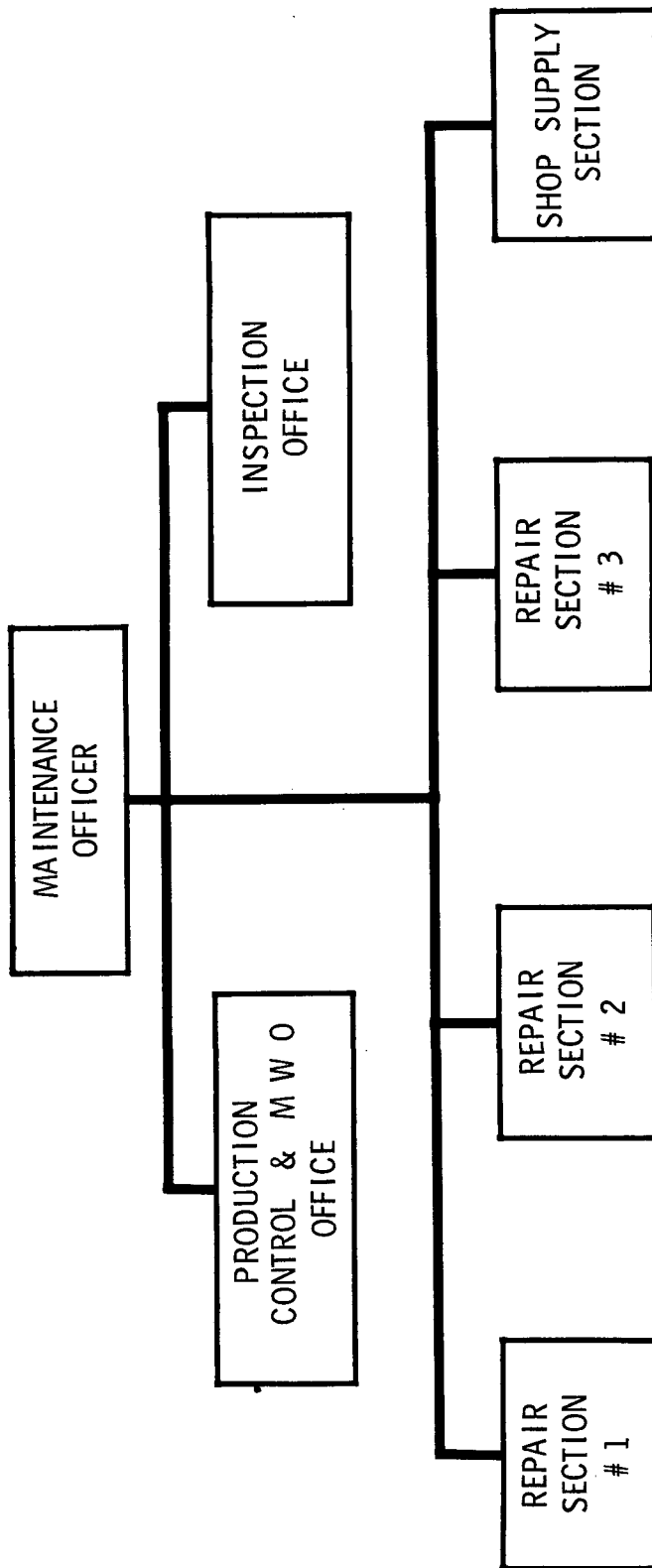
may differ according to the types and numbers of equipment being supported, and they may or may not be within one physical structure. Furthermore, the basic organization is essentially that used in mobile TOE field maintenance shop.

164. Administration and Supervision Organization

a. *Shop Officer.* The shop officer (who may also be the maintenance officer) is responsible for accomplishment of the shop's assigned mission and exercises overall supervision of shop operations. He may be assisted by an operations officer. His primary duties generally include—

- (1) directing and administering shop activities and coordinating the efforts of all maintenance personnel;
- (2) coordinating with organizations supported by the shop to insure mutual understanding of field maintenance policies and problems and an orderly flow of work from supported units to the shop and return to units;
- (3) directing the preparation of shop plans for meeting current and future maintenance requirements;
- (4) issuing directives for proper shop operation and management;
- (5) serving as a staff officer and technical advisor to the cognizant installation technical service officer on all matters regarding maintenance policies and procedures.

b. *Production Control Office.* The responsibility of the production control office is to establish and maintain, in accordance with technical service and local policies, effective control over all items being processed, repaired



TYPICAL FIXED (non-TOE) FIELD MAINTENANCE SHOP ORGANIZATION

1 July 1961

Figure 16. Typical fixed (non-TOE) field maintenance shop organization.

and/or modified in the shop. The main function of production control are forecasting, scheduling, routing, and followup.

c. Modification Work Order Office. Processing Modification Work Orders (MWO's) in some shops is under the jurisdiction of production control; in others it is under a separate office or section. MWO control involves close coordination with station supply to insure that all affected items are modified. The processing of modifications is also correlated with production control and the supply section to provide for compatible workload scheduling and a steady flow of parts, tools, and material for any required modification.

d. Inspection Office. The inspection office (section or unit) supervises all inspection policies and procedures used at the shop. The major responsibilities of this office are to—

- (1) inspect equipment in the hands of using units as required and/or upon receipt of unserviceables at the shop to determine the nature of the unserviceability and the chargeable first and second echelon deficiencies, and to report pertinent parts and repair data to the production control, supply, and repair sections;
- (2) conduct in-process and final inspections to insure that work is progressing satisfactorily and, upon completion of the job, to insure that the prescribed repair standards have been met.
- (3) insure that shop practices conform with the shop SOP, technical manuals, other technical and administrative publications and command directives.

165. Shop Supply Section

a. The shop supply section is responsible for determining maintenance supply requirements and maintaining proper stockage levels of supplies and repair parts. Shop supply must be

distinguished from the station supply section of the shop's parent technical service, which is responsible for station-wide acquisition, receipt, storage, inspection, control, disposition, and accounting of a given technical service's material. The shop supply section performs its functions on a necessarily more limited, internal basis.

b. The supply section, depending upon its size, generally will include a shop supply chief or leading foreman, parts predeterminers, parts keepers, tools keepers, and record clerks. In some large shops the supply chief reports directly to the maintenance chief or his operations officer. In other cases, particularly where there are several medium or small shops within a single technical maintenance section, the shop supply chief will be responsible directly to the shop foreman.

166. Repair Sections

a. A repair section, or unit, within a field maintenance shop is responsible for performing all necessary field maintenance repair operations prescribed by technical service standards and the shop SOP. A repair section is headed by a lead foreman and includes those technical specialists, mechanics, and laborers appropriate to the technical service. It also usually includes one or more clerk typists. In a single shop there may be several repair sections working on one type of equipment and each section may be broken down into individual shops.

b. The lead foreman of a repair section is responsible for the accomplishment of all work submitted to his section on a Work Order Request and Job Order Form and for any further authorized necessary work revealed during each job performance. He is also responsible for collaborating with production control and supply sections to insure, respectively, balanced workloads and availability of repair parts. In addition, the lead foreman supervises all personnel within his section.

Section II. PRODUCTION PLANNING AND SCHEDULING

167. The Planning and Scheduling Problem

a. In a fixed field maintenance shop, as in the depot shop, the production control unit is in charge of production planning and scheduling.

Generally the production control unit at the field shop cannot project production plans very far into the future. Unlike the depot shop, it does not receive a breakdown from higher com-

mands of the expected workload for the next quarter or next month. The field shop supports specific units; it cannot predict with any great degree of certainty when the equipment assigned to those units will require third or fourth echelon repairs. Production scheduling usually can be started only after a work request for repair of an unserviceable equipment of a supported unit is physically received in the shop and not in anticipation of receiving a steady flow of unserviceable items of equipment of a specific type. Thus, most field maintenance shops are only able to schedule on a day-to-day, or at best, on a week-to-week basis. On some occasions even the shop's daily or weekly production schedule may have to be disrupted to fulfill an emergency requirement. In other cases, if the shop or subshop is supporting a satellited ARADCOM unit, it will be on a constant 24-hour alert to repair immediately any of that unit's defective equipment. Because of the unpredictability of the workload, a steady production flow frequently cannot be maintained, and funds, labor, and materials may often be inefficiently employed.

b. Although in many cases unpredictability of future workload requirements is inherent in the nature of the field maintenance shop mission, certain measures can be taken to even out the volume of the workload input and facilitate more reliable production planning. The shop might resort to commercial contracting whenever the workload becomes too heavy for the shop to handle with reasonable efficiency. The shop should maintain close liaison with higher headquarters and keep informed of planned maneuvers and other training exercises.

c. As another way of evening out the workload flow, the shop might periodically inspect all major equipment which it supports and then establish a definite repair schedule to correct the actual or incipient deficiencies which it uncovers. In other instances, the type of equipment supported may indicate probable repair requirements. Equipment whose incidences of unserviceability is highest during certain seasons might be called into the shop periodically for inspection and necessary repair.

d. At many shops, the use of a maintenance float helps to balance the workload. The maintenance float is composed of selected end items

and major assemblies essential to the tactical mission of supported using units. It is held at the field maintenance shop and is drawn upon whenever necessary to provide a using unit with immediate replacement or temporary substitution of an essential item that is being repaired. The items selected for the float are determined by the cognizant technical service and the quantity of each item to be held is calculated on the basis of the total number of each such item supported by the field maintenance shop and the time necessary for repair of the defective item at the shop and return to the using unit. The basic purpose of the float is to insure that operating units are always supplied with essential equipment so that the tactical mission is not impaired. However, the field maintenance shop gains certain other advantages from its use. When a float is used, the shop is not continually required to halt scheduled production operations in order to make emergency repairs on essential items. The float allows the shop a scheduling cushion; essential items that are to be repaired and returned to the float can be more evenly phased into the production process. Postponement of repair of float stock items must be very limited, or the existing float may be drawn down to dangerous levels. Its chief disadvantages lie in its cost. Yet despite the use of maintenance floats and other measures field maintenance shop production planning and scheduling is usually uncertain. Too many variable and unpredictable elements exist to allow any reasonable assurance of reliability.

168. Scheduling Procedures

Most field maintenance shop production scheduling does not begin until the shop production control office receives a Work Request and Job Order (DA Form 811) from a supported unit for maintenance of an unserviceable item. Usually the equipment accompanies the work request, but in some cases, the using unit only sends in the work request and waits until the production control office directs it to turn in the equipment. Once the equipment is received, it is given a thorough inspection and its economic reparability is calculated. The inspector then decides whether to repair the equipment, evacuate it to a depot maintenance

shop for fifth echelon repair, or recommend its disposal or salvage. When the item is to be repaired at the field shop, the production control office assigns it a repair priority based on its criticality to the owning unit and schedules it into the shop for the required maintenance when necessary parts and labor become available. If the job has a high priority, parts and labor may be transferred from a less urgent job in order to complete the work as rapidly as possible. For a complicated or new repair job the production control office may draw up a detailed standing operating procedure (SOP), which describes, step-by-step, the movement of the item through the shop and the personnel who will do the work. For minor or routine

jobs the shop foreman may direct the routing of the job and assign the required personnel. In either case, the work should be carefully planned so that it flows through the shop in a continuous and orderly fashion without delays or backtracking. Repair operations should be broken down by type and the work assigned to definite individuals or sections. For production control purposes, it may be desirable to use some form of control board to provide a visual record of the progress of various jobs through the repair process. On a typical control board the various jobs are identified by tags or discs (of various colors, according to job priority) which are moved across the board as the work moves through the shop.

Section III. PRODUCTION MANAGEMENT

169. Shop Layout

a. Since most field maintenance shops do not repair enough similar unserviceables to make a production line feasible, almost all shops use a bay shop layout. However, if a large enough volume of certain items, such as generators or transmissions, require repetitive repair operations, a special section should be set up to repair those items. This labor specialization can result in more economical shop operations.

b. Whenever a shop layout is established or changed, the plans for its operation should be based on a careful consideration of the authorized echelon of maintenance, the expected workload, and the available personnel, tools, and equipment. Each phase of the shop operation must be carefully analyzed to determine the amount of space needed for the various repair sections and the best location for each. The size of some sections is determined by the size or quantity of the repair equipment used, while the size of others is governed by the size of the unserviceable items to be maintained. The bays or sections performing sequential or allied operations on similar items should be grouped close together, so that an unserviceable item can move with maximum speed through the shop without backtracking.

c. In field maintenance shops, most unserviceable items move through the repair process individually on separate job orders, and the identity of the item is retained throughout the

course of repair. The job order specifies the detailed repairs to be performed; replacement of unserviceable assemblies, subassemblies, or component parts is made as directed. Parts costs are accumulated from issue slips and charged directly to the individual job. Labor costs are accumulated and charged to the job from mechanics' individual time tickets.

170. Production Control Techniques

a. The functions of the production control unit at the field maintenance shop are somewhat different from those at the depot shop because of the greater diversity but smaller volume of operations in field maintenance shops. The production control unit serves as the maintenance shop officer's assistant in planning, scheduling, and coordinating production operations, and in establishing effective shop layouts. It also develops production standards for use in analyzing production performance and in estimating job order work schedules. The production control unit maintains a reporting system to record actual production performance and the subsequent analysis of it.

b. The production control reports used in the field shop are generally similar to, but usually simpler than, those used in depot shops. Often, the reporting system may only consist of Work Request and Job Order Forms (DA Form 811), workers' individual time cards, repair parts issue slips, and summaries of these forms. In

some instances daily shop activity reports, production summary reports, production graphs and charts, and production difficulty reports may be used. A significant report developed at field maintenance shops is DA Form 1510 (Maintenance Readiness and Field Maintenance Costs), which is accompanied by DA Form 1510-1 (Maintenance Readiness of Representative Critical Equipment). Basically, as stated in AR 750-15, the report is designed to provide—

- (1) data to Headquarters, Department of the Army, and general operating agencies for essential control and supervision over the execution of Army program objectives;
- (2) Headquarters, Department of the Army, and general operating agencies with integrated data required for development of program objectives and schedules, and other required purposes;
- (3) heads of general operating agencies with a means of demonstrating to Headquarters, Department of the Army, the degree of effectiveness being attained in their area of responsibilities in the use of resources and in justification of further resource needs.

The value of this report to the field maintenance shop lies in the “feeder” data generated in its preparation.

171. Inspection Procedures

a. The inspection system at a field maintenance shop generally is the same as at a depot shop. A complete technical inspection is made to determine the nature and extent of the work required and whether repair is economically justified. On the basis of the findings, a decision may be made to repair the item at the field shop,

evacuate it to a depot shop for fifth echelon repair, or otherwise dispose of it. In all cases, the responsible inspector determines whether lower echelons have maintained the equipment properly and have made all applicable modifications. If the inspection discloses evidence of neglected or unsatisfactory maintenance of a reparable piece of equipment, personnel from the using unit may be required to do their part of the work in the maintenance shop. In flagrant cases of neglect, formal reports are submitted to responsible commanders, recommending corrective measures or the placing of pecuniary liability for damage done to equipment.

b. In each kind of inspection the inspector's main problem is in defining standards of acceptable repair. Although in many cases various technical publications clearly state the dimensional, visual, weight, performance, and operational characteristics of a satisfactory item, in other instances the determination of acceptability is necessarily left to “the opinion of the inspector.” When a shop employs several inspectors, variations may often occur. Different inspectors may have different opinions about the amount and type of repair needed on a particular item. If one inspector in a final inspection finds defective a condition that was considered acceptable by another inspector in the initial inspection, confusion results. Time and funds may be wasted, and more important, the equipment will probably not be returned to the using unit as rapidly as might have been possible. Therefore, in situations where an inspector's opinion is called for, the maintenance officer must try to minimize any wide divergencies among inspectors. He might conduct additional inspector training or take other, more informal measures to standardize inspector judgements.

CHAPTER 16

PARTS SUPPORT FOR FIELD MAINTENANCE

Section I. SUPPLY AND MAINTENANCE RELATIONSHIP

172. Shop Stocks

Each maintenance shop contains an internal shop supply activity which is designed to maintain adequate working levels of the most commonly used parts. Although shop stock levels are not subject to accountable property controls, a simple form of stock record system is often essential.

173. Supply Mission in the Field

a. The mission of supply in relation to maintenance functions is to furnish the parts required to maintain equipment when and where the parts are needed. At accountable supplying activities, various criteria of supply performance are established which measure efficiency in terms of dollar inventory turnover, the percentage of customer demands that are filled from available stock as compared to the percentage that are forwarded to the next higher supply echelon, and the time consumed in processing customer demands. These are convenient, significant measures of performance in relation to internal supply standards. The final test of effective parts support is the length of time that needed equipment in the field remains inoperative while awaiting replacement parts. The chief cause of deadline equipment is lack of parts. Other repair resources, such as manpower and facilities, can be provided in exceptional circumstances by diverting them from low priority uses or by working them overtime. The lack of needed parts may, however, defy every attempt of the field maintenance unit to meet a pressing requirement.

b. Any delay in getting the required part to the maintenance point will depend on the process of transmitting the original demand back through successively higher echelons of supply until the demand can be satisfied. At

worst, the process may lead from an overseas area back to the CONUS supply point and may take several months to transact. The seriousness of an interruption in the supply and maintenance relationship is in direct proportion to the importance of the equipment to the military mission and its time out of commission.

174. Echelons of Supply

a. The echelons of supply as they relate to maintenance echelons are as follows:

- (1) Organizational maintenance units obtain repair parts supply support from direct support units or from designated supply points.
- (2) Support units (both direct and general) receive repair parts supply support from designated supply points or depots, and, when authorized, by procurement from local commercial sources or by fabrication.

b. The firstline of parts support for field maintenance is the shop stock which is kept in the vicinity of the working area and controlled by maintenance personnel. These parts are accessible to the repair crew with the least possible delay and procedural encumbrance. Shop stock also serves to reduce the number of transactions between repair and supply activities.

c. Items not on hand in shop stock are requisitioned from the supporting supply activity. In some cases this is the accountable property office at a CONUS station; in others it is the supply section of the direct or general support unit to which the maintenance shop belongs. In all cases where the supporting supply activity is operating under the Army Field Stock Control System (AR 711-16) the requisitions are effected by DA Form 1546. The supply

activities carry a broader range of parts than the shop and normally should be able to fill shop requests for parts on their stockage lists within 1 day. Items extracted to supporting supply activities take longer.

d. If the supporting supply activity does not carry the parts requested, the demand is transmitted to the next higher supply echelon. In CONUS, this will be the designated depot which is ultimately responsible for furnishing any authorized technical service item requested of it. AR 725-55 specifies the order and shipping time for overseas area.

e. For demands originating in overseas theater maintenance shops, further echelons are added to the supply system. Requests for items that are not stocked by the overseas-based direct or general support unit are passed to the Army depot and/or the theater depot, and finally, in the case of items which are not in stock in the theater, to the CONUS supply system. The long distances to overseas theaters complicate the job of making timely delivery of parts that have to be brought in from CONUS stocks. The major objective of overseas supply support is to speed supply between CONUS and the overseas user through improved communications and transportation methods. AR 730-30 establishes resupply time standards for supplying stock from the CONUS to an overseas user, the variations in resupply time depending on the type of requisitions employed and whether or not the item is authorized for stock by the using unit. AR 725-8 establishes the means of communicating with the Overseas Supply Agency. AR 725-55 establishes and assigns responsibility for each segment of the overseas order and shipping time cycle, to include basic time allowance for each portion of the cycle.

f. Requisitions from CONUS installations and from the overseas theaters (through the Overseas Supply Agencies) go to the distribution depot (or the National Inventory Control Point in the case of technical services with central accountability) which is designated by the technical service as initial source of supply. If the required parts are not on hand in the

CONUS depot system as a whole, emergency purchase action may be taken, as the last resort, in order to obtain them from the commercial producer.

g. At any state of the supply process, measures may be taken to speed up the delivery of specific parts which are required to reactivate equipment. These steps include special handling of priority requisitions and search for sources outside supply channels.

- (1) To expedite delivery, original requisitioners may under certain circumstances designate their request as "blue steak," "emergency," or "equipment deadline for parts." Priority classification has been an extremely effective way of meeting urgent demands. Blue streak requests from CONUS installations are filled from CONUS depot stocks in 1 or 2 days as compared to the 20 to 45 days required to fill routine requests from the same source. The abridgement in time is accomplished by substituting telephone-telegraph communication for mail, by maintaining round-the-clock service for demands at stations and depots, and by making delivery by air direct to the user.
- (2) CONUS depots and NICP's notify requisitioners of delays in filling requirements and of expected availability dates. To avoid the delay involved in waiting to get parts from the CONUS system, the requisitioner may search for local sources outside supply channels. These include local purchase on the commercial market, local fabrication, reclamation of parts from worn out end equipment (cannibalization) and lateral transfer among field activities. AR 750-50 provides instruction for resupply via cannibalization techniques. In the overseas theaters it is common practice to screen all such sources before transmitting urgent requirements to the CONUS supply system.

Section II. CONTROL OF SHOP INVENTORIES

175. Shop Inventory

a. Shop inventories are those held under the control of maintenance personnel within or close by the repair area. They do not include inventories held in the supply section at the direct or general support unit or in a CONUS station property account, since these normally are subject to specific control procedures prescribed in AR 711-16. Shop inventories are subject to less formal control procedures which are developed within limits established by individual commands.

b. Shop inventories may involve a significant commitment of time, facilities, and stock investment. At a minimum they will include inexpensive common-use items such as bolts, screws, washers, and cotter pins; depending on the supply support situation, they may also include parts and components such as valves, tubing, and generator assemblies. Effective management of such inventories is the responsibility of the maintenance unit commander.

176. Personnel

The ideal shop supply staff includes the parts chief who is in overall charge; the parts clerks who wait on customers, receive and bin stock, and post to the stock record cards; the parts supply specialists who identify by stock number and name the parts required to complete repair jobs; and possibly a tool man to maintain the tool crib and follow up the issue and return of special tools.

177. Stock Control

a. *Stockage List.* Demands for parts that are regularly kept in stock are filled off the shelf. Parts which are not in shop stock are ordered from the supporting supply accounts; this entails placing a separate order for each demand received. The order procedure makes use of the standard Army single-line requisition form, DA Form 1546, which furnishes one requisition document for each part ordered and thus provides a convenient method of maintaining a demand record by individual part.

b. *Stockage Criteria.*

- (1) Stockage criteria are expressed in terms of the number of demands occurring (not the quantity demanded) in a fixed base period. Selection of the appropriate criterion should be made with a view to limiting shop stock to parts for which there are regular, recurring requirements. The criteria applied at shop level should be no less restrictive than the corresponding criteria applied at the supply activity on which the shop depends for its support. In most cases, it is appropriate to apply more restrictive criteria at the shop than at the supply level. AR 711-16 provides selective stockage rules for appropriate supply activities.
- (2) Choice of the best possible rule for a particular situation will depend upon experience and experimentation. A voluminous stockage list containing many inactive items indicates the need to tighten stockage rules; delay and inconvenience caused by the inability of the shop to deliver parts on demand suggest the need to relax stockage criteria generally relaxation by lengthening the base period which is prescribed by stockage criteria is the safer course. The final objective is to find a reasonable balance between accumulation of stock and accommodation of demand.

c. *Stockage List Deletion.* Procedures for systematically retiring inactive items from the stockage list are essential for effective stock list control. They are needed particularly in military operations, which impose a high rate of changeover in equipment and parts, in order to keep unit stockage lists from growing out of proportion to the purpose served. As a rule, the criteria used to delete items from stock should be more relaxed than the criteria used to add them. Again, AR 711-16, AR 730-30, and AR 735-35, provide appropriate supply guidance.

- (1) Parts selected for stock should be handled by means of routine control

procedures whose purpose is to insure that stocks are replenished before they run out. Basic stock records must be maintained for each item to indicate quantities on hand, due in, and due out. Prompt replenishment is then effected by reference to two control elements — the requisitioning objective, which is the maximum quantity of stock on hand and due in to meet requirements, and the reorder point, which is the minimum quantity on hand and due in to permit replenishment before stock is exhausted.

Both of these control elements are expressed in terms of days of supply.

- (2) When these two control elements are established for each item in quantitative terms, stock control actions are governed by the following rules:
 - (a) Order when net assets (on hand plus due in minus due out) are at, or equal to, the reorder point.
 - (b) Order a quantity equal to the difference between net assets and the requisitioning objective.

Section III. MAJOR FIELD SUPPLY PROGRAMS

178. General

Maintenance represents the largest line item customer of the Army supply system. Virtually all recent developments in supply concepts have been designed to improve the support which is rendered by supply to field and organizational maintenance activities.

179. The Army Field Stock Control System

a. General. Army Regulations 711-16 requires that all technical services use standard forms and procedures in controlling and accounting for supplies which are held at installation level in the CONUS and at general or direct support unit level in the oversea commands. This standard system, known as the Army Field Stock Control System, is associated with distinctive supply concepts.

b. Single-Line Requisitioning. The single-line requisition (DA Form 1546) guarantees individual, appropriate treatment to each demand that is received from the field. Requisitions for items which are carried in stock are promptly filled. Those for items which are not in stock are identified and transmitted to the next higher echelon without being entered on the stock record, since the single-line document can be filled in stock number sequence and can itself serve as a temporary stock record. The single-line requisitions are submitted on a daily basis by using units directly to supply without consolidation at intermediate command echelons; in-process delays are thus reduced to a minimum. The objective of this requisitioning

method is to set up direct contact between the supply system and the ultimate user.

c. Improved Stock Record. The Army Field Stock Control System introduced a compact, manageable stock record. The new stock record permits the accumulation of demand data and provides for automatic transmission of current catalog data, including status and price changes, to the supply activity. It also provides a separate card (demand data card) for accumulating demand data, computing requirements, and maintaining stock level control. The card was designed to be detached from the basic record and returned periodically through technical service channels to agencies which are equipped to analyze the data and to use it in revising published parts lists and maintenance rates.

d. Demand Data. The new system introduced the concept of basing computation of requirements on demand experience rather than on issue experience. The change eliminates the distortion that is often present in the use of issue data. Issues may not materialize, despite high demands, if stocks are exhausted and not on hand to issue. Requirements based on issue data are then understated at the very time that stocks are in short supply. If a substitute is issued in place of the demanded item, requirements based on issue data tend to be overstated for the substitute and understated for the wanted item.

e. Selective Stockage Plan. This plan assumes, for reasons of economy and mobility, that the Army cannot afford to stock a full

range of repair parts at forward echelons. It states the principle that a relatively small percentage of all required parts will account for a relatively large percentage of all maintenance demands. Restricting stockage at installation level to the fastest moving parts, it is concluded, will have no perceptible effect on maintenance support while producing overall system benefits. Emphasis is placed on fact delivery, rather than on forward distribution, of the slow-moving, nonstock items.

180. The Economic Inventory Policy (EIP)

a. The Economic Inventory Policy (EIP) is a program which makes use of economic and statistical principles in the management of inventories. Basically it compares the elements of the cost to supply an item. Its primary function, however, is to balance costs and to determine the average stock level and order frequency at which total costs of supply will reach the lowest possible point. (FM 38-1 describes EIP in considerable detail.)

b. The major objectives of EIP are—

- (1) to increase the availability of stocks on hand to meet demands;
- (2) to reduce the workload which involves repetitive review and reorder of stocked items; and
- (3) to reduce overall supply costs, including the cost of administration and the cost of inventories.

c. EIP includes the following policy elements:

- (1) *Economic stockage policy.* EIP accepts the principle of selective stockage, but supplies an explicit economic basis for making stockage decisions.

The EIP applies stockage criteria selectively, giving some consideration to item values. Low-unit-cost items are stocked on the basis of more lenient criteria than high-unit-cost items. The effect is installation stockage of a larger number of items but of a smaller total dollar investment than under previous stockage rules, which applies a uniform criterion to all items.

- (2) *Statistical safety level policy.* For items that are regularly stocked, EIP includes a large enough safety factor in computation of requirements to allow for the inherent variability of demand. The policy is based on probability principles and adjusts each item's safety requirement to its own demand characteristics.
- (3) *Economic order quantities (EOQ).* EIP requires that item reorder policy take into account the cost of the administrative process involved, as well as the cost of the material ordered. In many cases, the more practical course requires larger and less frequent replenishment orders. Under EIP approximately 80 percent of installation stock list items are replenished once a year. These are the items with a low value of annual demand. Only a small fraction representing the highest demand value items are replenished as often as once a month—the rule that under prior regulations applied to almost all installation stocked items.

CHAPTER 17

ORGANIZATIONAL MAINTENANCE

Section I. RESPONSIBILITIES AND DUTIES

181. Echelons of Maintenance

a. Organizational maintenance is that maintenance which a using organization has the authority and responsibility to perform on its own equipment. As a general rule, it consists in inspecting, cleaning, servicing, preserving, lubricating, and adjusting equipment as required. It may also include replacement of plug-in type components and minor parts which do not require highly technical skills or expensive, complicated, or bulky test equipment and tools.

b. In the Army establishment, multiple part manuals prescribe the function of the various echelons of maintenance. TOE's indicate the level of maintenance the particular organization is authorized to perform on its own equipment. Normally, this is first and second echelon maintenance.

(1) *First echelon maintenance.* First echelon maintenance is performed by the user, wearer, or operator of the equipment. It includes the proper care and operation, cleaning, preservation, and lubrication of the equipment, and any adjustment, minor repair, testing, and parts replacement prescribed by pertinent technical publications. Although this is the lowest maintenance echelon, it is by no means the least important; heavy maintenance costs and equipment failures can often be avoided by careful use and surveillance of equipment at the user level. This echelon may, however, be a potential source of trouble if repairs or adjustments are attempted by unqualified personnel with improper tools or inadequate test equipment.

(2) *Second echelon maintenance.* Second echelon maintenance is performed by specially trained maintenance personnel who are assigned to a using organization and includes scheduled preventive maintenance services, unit servicing of equipment, adjustments beyond those required in first echelon maintenance, authorized component replacement, technical advice and assistance to first echelon personnel, and assistance in command inspections. The maintenance skills of the personnel are broader than those of the first echelon users, and the tools and parts authorized to them are more complex. However, the maintenance performed at this level is still minor in scope, and operators often participate in the second echelon work on the equipment to which they are assigned. They also report all malfunctioning of equipment to the unit mechanics.

c. The basis of good organizational maintenance is preventive maintenance, which is the systematic care, inspection, and servicing of equipment to keep it usable and to detect and correct incipient failures before expensive and time-consuming repairs or replacements are required. It is the responsibility of commanders at all levels and echelons.

182. Command Responsibility

Supervision and control of organizational maintenance are exercised through command channels. AR 750-5 states, "Commanders are required to insure that all equipment issued or assigned to their command is maintained in a serviceable condition and is properly cared for and used, and that personnel under their com-

mand comply with technical instructions." In both garrison and field operations, organizational maintenance functions, which include preventive maintenance services, generally are similar in scope and are the responsibility of all unit and organization commanders.

183. Duties of Organizational Maintenance Personnel

The Table of Organization and Equipment (TOE) lists the personnel who will perform organizational maintenance in a particular unit. The number of personnel assigned and the kind of work done depend on the quantity and type of equipment with which the unit is equipped. Generally the following personnel are assigned to supervise and/or perform organizational maintenance in the unit.

a. Maintenance Officer. The maintenance officer is the direct representative of, and technical adviser to, the unit commander on matters of organizational maintenance. Although his duties vary with the size of the unit and the equipment it uses, his primary responsibility is essentially the technical supervision of maintenance. His specific duties include—

- (1) command of the maintenance platoon or section in the unit;
- (2) supervision of the instruction given to equipment operators and the training of maintenance personnel;
- (3) preparation of the maintenance work schedule, based on the availability of parts, tools, equipment, the level of experience of personnel, the condition of equipment, and the tactical situation;
- (4) periodic inspection of equipment to make sure that organizational maintenance conforms with established standards;
- (5) staff supervision of periodic preventive maintenance services performed in the unit;
- (6) assistance to commanders making command inspections;
- (7) coordination with the unit supply officer on repair parts requisitioning and supply procedures, and maintenance of property records of equipment as-

signed to the maintenance platoon or section;

- (8) establishment and enforcement of fire prevention and safety regulations around equipment and in the maintenance area.

The maintenance officer should have technical training and a specific aptitude for the duties involved. It is desirable, however, that all unit officers have opportunity to benefit from maintenance training and experience.

b. Maintenance Sergeant. The maintenance sergeant assists the maintenance officer in supervising organizational maintenance and generally is selected on the basis of his technical and mechanical knowledge and ability. He is responsible to the maintenance officer for the performance of scheduled preventive maintenance services, assigning mechanics to perform repairs and scheduled services, instructing and assisting equipment operators in performing first echelon maintenance, enforcing all maintenance procedures and policies, and reporting all indications of negligence, carelessness, or abuse of equipment.

c. Unit Mechanics. Mechanics are designated to perform second echelon maintenance in the unit to which they are assigned. They are specially trained personnel who are given the basic tools necessary to make minor repairs, adjustments to replace authorized components, and to perform periodic preventive maintenance services. They may be called upon to advise operators in the care and use of equipment, and they may also participate as members of inspection teams within the unit.

d. Equipment Operators and Users. Equipment operators and users perform first echelon maintenance services, repairs, and inspections on their equipment as authorized by the technical manuals and field manuals pertaining to the equipment. Under supervision, they may participate in second echelon services. One of the most important functions of an operator or user is to perform scheduled daily and other preventive maintenance services on his equipment.

e. Other Personnel. Additional personnel, such as clerks parts specialists and toolkeepers may be authorized by the TOE for units of

battalion size. Clerks generally work under the supervision of the maintenance sergeant in the preparation of requisitions and reports, and in the maintenance of records. Parts specialists are also supervised by the maintenance sergeant. Their duties include—

- (1) maintenance of repair parts records and preparation of requisitions;

- (2) storage and identification of repair parts; and
- (3) issuance of repair parts to unit mechanics and equipment users.

In smaller units, the maintenance sergeant or designated mechanics may perform the functions of clerks and parts specialists.

Section II. PREVENTIVE MAINTENANCE

184. Preventive Maintenance Procedures

a. AR 750-1 calls preventive maintenance "the cornerstone of efficient and economical maintenance." Preventive maintenance is an integral part of organizational maintenance responsibility and is given special emphasis because of its importance through the Army establishment.

b. Preventive maintenance services are performed on a periodic basis. They normally consist of daily maintenance services performed by assigned operators, who are assisted at times by organized first echelon teams, and bi-weekly, bimonthly, and/or quarterly services performed by organizational mechanics and operators.

- (1) *Daily maintenance services.* Daily maintenance services may be divided into three parts:

- (a) *Before-operation service.* These services are performed on the equipment to determine whether it is operable and whether conditions have changed since the last after-operation service (TM 9-2810). This service should never be omitted, particularly in combat where the consequences of equipment failure are most serious. Upon completion of the service, the operator should inform his appropriate superior of his servicing.

- (b) *During-operation service.* This service consists of noting any unusual or unsatisfactory performance of the equipment or its parts or components during operation. Any deficiencies observed should be investigated, corrected if author-

ized and possible, and reported to the proper personnel.

- (c) *After-operation service.* This service prepares equipment for return to operation without delay. The operator must inspect the equipment for damages or malfunctions that may have occurred during operation and correct those that are within his authorization. He is required to report his actions and any defects which he is not authorized to correct to the responsible person. It is important that supervisors make periodic inspections to insure that operators perform these duties. Defects that are beyond the authorization or competence of operators are corrected by unit mechanics or sent to a higher echelon maintenance shop.

- (2) *Periodic services.* These services, which are scheduled according to miles or hours of operation, or time intervals (weeks or months), are performed by organizational mechanics assisted by the operators of the equipment. A thorough inspection of the equipment and any necessary repairs authorized at the unit level are made to insure trouble-free operation until the next periodic maintenance service. Periodic services are designed to obtain the maximum useful life from parts and components consistent with their life expectancies and probable future operations. Detailed procedures to be followed in performing periodic maintenance services are found in the technical manual and the

lubrication order for the specific item of equipment. In certain instances, commanders may authorize a reduction in the interval between periodic maintenance services. During combat, field exercises, and maneuvers, or at other times of intensive equipment usage, maintenance services are conducted at intervals determined by the unit commander.

185. Responsibility for Preventive Maintenance

Since preventive maintenance is an integral part of organizational maintenance, the responsibilities for the proper implementation are the same as those for organizational maintenance. However, within this broader framework, the Army has made special efforts to emphasize the responsibilities for preventive maintenance. This responsibility is placed directly on the commander.

186. Purpose and Limitations of Preventive Maintenance

a. The purpose of preventive maintenance is twofold. From a tactical point of view, it is aimed at keeping equipment fully operable during periods of use. Essentially, such services are a matter of tactical necessity.

b. From a logistics point of view, it has an additional purpose: to prolong the life of equipment, parts, and components. Much of the present workload in higher echelon maintenance shops results from improper or neglected servicing at the user level. Proper preventive maintenance services, therefore, reduce the overall logistics requirement for labor, facilities, parts, and transportation.

c. Not all preventive maintenance services achieve both of these purposes. The service performed on nonmoving parts, e.g., testing and replacing, is designed to insure that equipment will operate when needed, but it does not necessarily prolong the life of the parts or the equipment. On other parts, the services required to place equipment in immediate operating condition may be less thorough than those required for optimum service life. Since the first responsibility of troop units is for combat effectiveness, users may, under pressure, tend to omit the additional services. In the long run

this neglect affects the user as much as the logistics system which supports him by leading to major breakdowns and denial of basic equipment to operating units.

d. Field conditions often complicate the performance of preventive maintenance services. Tactical situations and the nature of the equipment often make adherence to a regular and simplified maintenance schedule impossible. Equipment that is only used intermittently or which is on a standby basis requires a different degree of maintenance from that required for equipment in constant use. This equipment may not be neglected entirely because of possible deterioration. On the other hand, periodic servicing that does not take use into account is wasteful of time and materiel.

e. Preventive maintenance schedules should be developed on a regular basis which will insure performance of essential services. At the same time, they should be flexible enough to include servicing of equipment used in different tactical situations or under abnormal conditions. It is equally important that preventive maintenance not be carried to the point of excessive servicing. Personnel can waste valuable time and materials in making continual checks for defects that occur only infrequently. In some cases, particularly for standby or irregularly used items, the equipment may be "overmaintained," and its readiness for tactical operations and the length of its useful life actually reduced because of excessive servicing. Preventive maintenance services by organizational maintenance personnel must be carefully controlled and limited to the minor repairs and adjustments that are specifically authorized.

f. Even the best preventive maintenance services will not eliminate all equipment failures, as those caused by accidents, combat damage, or extreme field conditions. Nor will they prevent unforeseen failure of equipment in normal operation, although an alert operator will often detect the symptoms of failure in his before-operation or during-operation check. Most important of all, the damage resulting from careless or improper operation of equipment cannot be forestalled by preventive maintenance although its effects can be alleviated to some degree. At the organizational level the equipment operator usually does the preven-

tive maintenance servicing, and if he is negligent in using the equipment, he will probably be negligent in servicing it. The preventive maintenance servicing by operators known or suspected to be careless in using equipment should be closely monitored.

g. The commander's responsibility for preventive maintenance includes not only the establishment and supervision of schedules and procedures, but also the evaluation of results. Inspections, as well as direct observation, will give him much useful information. At the same time, he may wish to obtain regular compilations or tabulations of significant maintenance information which will give him a comprehensive picture of maintenance effectiveness in his unit. Such tabulations might include the following:

- (1) The number of defects, by type and period observed, for each class of equipment. This will indicate increases or decreases in equipment failures.
- (2) The number of equipment units down for repairs in each period, and the time required for such repairs. This information is particularly useful if the down time can be related to the use periods of the equipment. When possible, proper maintenance scheduling should avoid deadlining units of equipment during the periods when they are scheduled for use.
- (3) The ratio of failures in use to failures detected during maintenance servicing. This ratio will provide some indication of the effectiveness of preventive maintenance in forestalling failures of parts and equipment in use.
- (4) The ratio of salvaged unserviceables to total unserviceables returned by the unit.

These and other statistical indicators may give the commander periodic statistical information on the maintenance effectiveness of his unit. At the same time, they must be used with caution if misleading conclusions are not to be drawn. A statistical, like a visual, indicator is only a starting point, a signal that further investigation is necessary.

187. Limits of Organizational Maintenance Responsibility

a. The emphasis on preventive servicing as the primary element in organizational maintenance implies that further responsibilities of the organization for repair of equipment are strictly limited to those specified in applicable manuals and directives. When failures occur, maintenance policy will often require the evacuation of the equipment to a higher echelon of maintenance. This can cause acute problems in actual operations and represents one of the major difficulties encountered in organizational maintenance. While evacuation may be required, the equipment in question may also be, or appear to be, essential to the immediate mission of the unit. In practice, the alternatives for the unit may be: if the equipment is still operating, to continue to use it until it fails completely; to attempt unauthorized repairs; or to evacuate the equipment to the field maintenance shop. The pressures to use one of the first two alternatives may be very strong, particularly in combat, since the choice may appear to be between having the equipment, no matter how badly it works, and not having it. Even the minimum time for repair and return may be too long.

b. While enforcement of maintenance policy and regulations is still vitally important, it does not appear likely, by itself, to eliminate the problem. A broader attack involving improvements in basic maintenance and supply techniques has been undertaken by the maintenance organization. These include—

- (1) increased modularization to permit more maintenance at the organizational level without requiring more extensive technical skills;
- (2) more direct exchange of parts and modules where stockage of such items is not feasible at the organizational level
- (3) increased on-site repairs by mobile field maintenance teams;
- (4) greater overall reliability in equipment.

188. Necessity and Responsibility for Training

a. In accomplishing its assigned missions, the Army depends on personnel who are

thoroughly trained in the proper operation and maintenance of equipment. It becomes increasingly difficult to insure the proper use and care of equipment as equipment becomes progressively more complicated.

b. Commanders at all levels are responsible for training their personnel in the proper operation and maintenance of the equipment they use. Commanding officers may alleviate the burden of training through proper utilization of service schools and training programs of parent organizations.

(1) To fulfill this responsibility, it is necessary to have a training program within the unit which is compatible with the training program of the parent organization. The unit program should include tabulation of the specialist skills required under the applicable TOE with a matching list of the men who are to fill those jobs, target dates by which specialist training is to be completed, and the means by which the training is to be accomplished, i.e., USCONARC or theater specialist schools, unit schools, or on-the-job training.

(2) The commander must also make effective use of the trained men. Because of shortages of personnel and the understandable wish to "get a job done," a competent man is often assigned to work for which he is not trained, while the task he knows best is handled by an untrained man or is neglected entirely. Situations like this arise frequently, and, in the light of events at the moment, they may be readily rationalized. Yet this is wasteful of skills that have been gained with a great expenditure of time and money. Under these conditions the specialist feels that his training was unnecessary or is unappreciated, and equipment suffers from lack of proper care.

c. Service schools are by far the most efficient means of training specialists, particularly as the specialty becomes more complex and elaborate equipment is needed to train the men

who will use and maintain it. Learning the particular specialty becomes a full-time job, and the student associates during his duty and off-duty hours with other men with similar backgrounds, who are acquiring the same skills.

(1) Unit commanders often object to sending personnel to service schools. Common reasons given are that the unit is already shorthanded, that the soldier gets away from the environment and tradition of his own unit, or that equally good training could be provided within the unit itself. These objectives are for the most part shortsighted or invalid. The absence of any men from the unit will cause some temporary inconvenience, but this must be viewed in the light of the man's increased effectiveness after he completes his training.

(2) Selection of personnel to attend unit and organization schools must be controlled as carefully as selection for service schools. The criteria for selection will vary between the two, but the impression must not be allowed to grow that the unit school is inferior. There are subjects that can be taught as well locally as at specialist schools, and this must be recognized by student, instructor, and commander alike without attempting to rate the schools in quality. A good unit school which does not attempt tasks beyond its natural limitations can be just as good as a service school in the same limited area.

d. On-the-job training of specialists is in many ways the least satisfactory. Yet, because of the restrictions placed on the other two, it is the one most frequently employed. On-the-job training can be given whenever a particular piece of equipment is operated or undergoes inspection or maintenance. The essential element is that the equipment is in normal or near-normal use. The individuals being trained work under the close supervision of a competent specialist who instructs them in particular tasks, demonstrates the correct method of performing them, and then sees to it that they are properly performed. The work done on the

equipment is normal work that would have to be done in any case, and as long as it is properly performed, it is beneficial to the unit and may free other men for more difficult or urgent work. It is essential that on-the-job training not be used as a means of relieving mechanics or other qualified specialists from routine work. The work which trainees perform must be both interesting and instructive. It is necessary that the instructor have an orderly plan of work to be done, that the reason for the work be clearly explained, and that work during successive training periods progress logically from the simple to the more complex. A lesson plan for on-the-job training is as essential as in any other kind of instruction; only its format and coverage will be different.

e. All training schedules provide periods for preventive maintenance training. This is intended as a training and not as a housekeeping period and demands the same attention to lesson plans, instruction, and supervision that any other training period does.

f. The unit commander must give personal supervision to maintenance training carried on

within his unit and should be able to assess the results of such training through inspections and the use of various types of maintenance indicators. Of particular interest to commanders is the Senior Officers' Preventive Maintenance Course at Fort Knox, Ky. It is a 1-week, integrated program of instruction which covers preventive maintenance of equipment furnished by all technical services. Commanders and key staff officers learn the critical importance of effective preventive maintenance in training and combat operations. It is basically concerned with the management of maintenance rather than the technical details involved in repair, replacement, storage, and surveillance of equipment. Particularly emphasized is the use of preventive maintenance indicators; typical PM indicators of classes of equipment are demonstrated and their practical use is stressed. These devices are used in recognition of the fact that senior commanders (except in the technical services) can devote only a small portion of their time to maintenance and the technical characteristics of the equipment in the units they are to command.

Section III. ORGANIZATIONAL MAINTENANCE PUBLICATIONS, RECORDS, AND REPORTS

189. Publications

a. Maintenance publications are indispensable in the proper training of personnel, and it is the responsibility of the unit commander to have all required and applicable publications for the operation and maintenance of equipment in his unit. All too often, an equipment operator or a unit mechanic lacks essential publications simply because they have not been requisitioned. The unit commander must know what maintenance publications are authorized, and he must get them into the hands of the men who need them in their work. He must follow up to insure that the manuals are being used.

b. Essential organizational maintenance information is contained in a variety of Army publications. The basic ones are Army Regulations, the 750-series of which describes the Army maintenance system and provides the framework for an organized, planned, and systematic maintenance program. Two of these regulations, AR 750-5 and AR 750-8, give the

essentials of the system and are vital to the unit commander's understanding of it.

(1) AR 750-5 defines command and technical responsibilities for the maintenance of materiel. It describes the three categories and five echelons of maintenance, discusses inspections and applicable reports and outlines Army policy on equipment modifications.

(2) AR 750-8 covers command maintenance inspections (CMI) in detail. Seven appendixes give the standing operating procedures for the CMI of each technical service, including the scope of the inspections, the forms used, and the method of calculating numerical ratings which are provided.

c. A second source of essential organizational maintenance information can be found in Army technical publications.

(1) A multiple part technical manual (each part corresponding to an echelon

of maintenance) is prepared by the technical service for each item of equipment for which it is responsible. The manual provides operating and maintenance instructions for the item, lists the available repair parts and required special tools, and provides requisitioning authorization for both parts and tools. For organizational maintenance purposes, only Parts I and II are issued to first and second echelon personnel. Part I, Operator's Manual, contains operating, preventive, and minor maintenance information pertinent to the equipment user, operator, or crew. It also includes a list of repair parts and special tools authorized to be carried with the equipment. Part II, Organizational Maintenance Manual, contains maintenance information and data pertinent to the units and organizations authorized the equipment. Also included is the Maintenance Allocation Chart (MAC), which shows all the repair operations authorized to be performed by the various maintenance echelons, plus a list of repair parts and special tools authorized for organizational maintenance. Parts III, IV, and V contain only that information and data needed at each succeeding higher echelon of maintenance. Of course, these multiple part manuals are combined when echelons of maintenance are combined or for other reasons it is practicable to do so.

- (2) Technical bulletins are distributed when technical information must be disseminated to the field prior to its inclusion in technical manuals. The bulletins are numbered in the same order as the corresponding technical manuals.
- (3) Lubrication orders are lubrication instructions published for each end item of equipment providing information on the types of lubricants required, frequency of lubrication, special fittings, permissible pressures, and similar data. Normally, only one order is

used per item, but some equipment may have several lubrication orders if different technical services are responsible for different components. The orders are numbered in the same series as the pertinent technical manual.

d. In addition to official publications, there are several miscellaneous publications that often yield valuable organizational maintenance information. Equipment manufacturers often publish operating and preventive maintenance handbooks which they issue with their equipment. Several of the technical services publish informal maintenance service letters to disseminate new or improved maintenance techniques. "PS," The Preventive Maintenance Monthly, a pocket-size magazine which illustrates various operating and maintenance problems and offers solutions, is published monthly by the Department of the Army for organizational maintenance and supply personnel; the language is informal and the illustrations are colorful and often technically detailed. The magazine is circulated to all units and commands of the Army. Valuable information can often be obtained from articles published in the various unofficial service publications. These articles are frequently based on the writer's experience and, being unofficial, often contain the writer's views on controversial subjects which may stimulate the reader's thinking.

e. In addition to the official and miscellaneous unofficial publications which can be procured from various external sources, the unit commander may, within his own unit, prepare documents that will improve maintenance operations. A most useful document of this type is a standing operating procedure (SOP) for maintenance. An SOP should include the following elements, with the degree of detailed discussion of each element depending upon the particular requirements of the unit.

- (1) *References.* All appropriate maintenance SOP's and directives from higher headquarters, including Department of the Army publications, should be referenced.
- (2) *Responsibilities and duties.* The maintenance responsibilities and functions

of the staff and subordinate commanders should be described in detail.

- (3) *Operations.* Maintenance operating policies should be discussed, including field maintenance support, the direct exchange system, on-site repair, scope of maintenance authorized at each echelon, and support of attached units. A discussion of supply procedures should also be included.
- (4) *Inspections and tests.* All supplemental local requirements for maintenance inspections and tests, in addition to Army regulation requirements, should be discussed, including inspection procedures, frequency, minimum standards desired, and reporting and followup practices.
- (5) *Training.* The maintenance training program for all personnel should be outlined, including the policy on service school quotas, the procedures established for unit schools, and the program for on-the-job and other, more informal, methods of maintenance training.
- (6) *Reports.* All periodic reports required by local and higher headquarters should be listed.

f. In preparing SOP's, strict care should be observed not to include data and information that are already covered adequately elsewhere. An SOP should only include those detailed instructions that are peculiar to the particular unit, citing references to AR's, technical manuals, directives from higher headquarters, and other pertinent documents.

190. Records and Reports

a. Among the tools available to evaluate equipment maintenance are organizational maintenance records and reports. To utilize them fully, the unit commander and other personnel who "need to know" must understand the record keeping and reporting system and know where to find the right information in a minimum amount of time. Adequate maintenance records permit the commander to check on the maintenance status of any particular item of equipment and the accomplishment of specific tasks and procedures. He can focus his

attention on major maintenance problem areas and take appropriate remedial action, whether such problems are shortages or lack of training of personnel, faulty supervision, inadequate supply support, operator abuse of equipment, or careless dispatching. When adequate records are not kept the commander cannot exercise necessary control of his operations. Such inadequacies may cause duplications of parts requisitions, nonavailability of parts when needed, and even failure to perform scheduled maintenance inspections and services.

b. A wide variety of records and reports are required for organizational maintenance operations according to the technical service and/or unit needs. Most of them are stated in AR's, FM's and other official publications, but commanders at any level may often direct additional requirements in order to provide more detailed information on certain local aspects of organizational maintenance. At all times the existing recording and reporting system should be closely evaluated and any new requirements carefully considered before being put into operation or an activity's maintenance program may become bogged down by numerous, overlapping, and sometimes irrelevant records and reports. The information provided by a record or a report should always be evaluated in relation to the personnel, time, space, and money that will be required to maintain it. (The value of the report should also be stated.) An excellent example of a valuable report is DD Form 110 (Vehicle and Equipment Operational Record) (fig. 17).

191. The Army's Plan for Equipment Record Revision (TAPER)

a. The Army has conducted a study to determine—

- (1) if the entire equipment records system provides minimum essential command and management control;
- (2) what maintenance, supply and engineering design management is required or needed by the user, intermediate, and national maintenance levels; and
- (3) whether the current records system generates the needed data.

VEHICLE AND EQUIPMENT OPERATIONAL RECORD									
DATE		TYPE		REGISTRATION NO.				ADMINISTRATION NO.	
10 APRIL 1960		TRUCK, CARGO, M211		5A31275				TK-19	
DISPATCHING ORGANIZATION		642 ^{MR} Tk. Bn.		TOTAL (Fuel gallons)		40		TOTAL (Oil quarts)	
1ST OPERATOR		SP-2 JAMES L. BOTTS		IN		1045		5972	
OPERATOR'S SIGNATURE		James L. Botts		OUT		0730		5927	
2D OPERATOR		PFC JOHN N. WALES		IN		1435		5997	
OPERATOR'S SIGNATURE		John N. Wales		OUT		1050		5972	
3D OPERATOR		PVT. HOMER P. FINE		IN		1930		6083	
OPERATOR'S SIGNATURE		Homer P. Fine		OUT		1450		5997	
4TH OPERATOR				IN					
OPERATOR'S SIGNATURE				OUT					
				TOTAL					
				REPORT TO					
				DISPATCHER'S SIGNATURE					
				REPORT TO					
				DISPATCHER'S SIGNATURE					
				REPORT TO					
				DISPATCHER'S SIGNATURE					
				REPORT TO					
				DISPATCHER'S SIGNATURE					

NOTE: Items checked by driver indicate appropriate Maintenance Service has been performed. Signatures of the dispatcher, operator, and user indicate that vehicle was dispatched and used for Official Government Business ONLY.

DD FORM 110
1 DEC 53

EDITION OF 1 DEC 49 MAY BE USED.

16-69857-2

TEAR OFF PORTION

PREVENTIVE MAINTENANCE SERVICES									
DATE		TYPE		REGISTRATION NO.				UNIT NO.	
10 APRIL 1960		TRUCK, CARGO, M211		5A31275				TK-19	
1. BEFORE OPERATION		OPERATOR		2. DURING OPERATION		OPERATOR		3. AFTER OPERATION	
		1ST 2D 3D 4TH				1ST 2D 3D 4TH		OPERATOR	
								1ST 2D 3D 4TH	
DAMAGE, PILFERAGE		✓ ✓ ✓		INSTRUMENTS		✓ ✓ ✓		LIGHTS AND REFLECTORS	
LEAKS GENERAL		✓ ✓ ✓		BRAKES		✓ ✓ ✓		SAFETY DEVICES	
FUEL, OIL, WATER		⊗ ✓ ⊗		CLUTCH		⊗ ⊗ ⊗		BRAKES	
ENGINE WARM-UP		✓ ✓ ✓		STEERING		✓ ✓ ✓		AIR TANKS (Drain)	
INSTRUMENTS		✓ ✓ ✓		ENGINE OPERATION		✓ ✓ ⊗		FUEL, OIL, WATER (Refill)	
SAFETY DEVICES		✓ ✓ ✓		UNUSUAL NOISES		✓ ✓ ✓		DRIVE BELTS	
TOOLS AND EQUIPMENT		✓ ✓ ✓		TIRES		✓ ✓ ✓		BATTERY LEVEL	
PUBLICATIONS		✓ ✓ ✓		LEAKS		✓ ✓ ✓		ANTI-FREEZE	
DD FORM 518		⊗ ✓ ✓		FUEL, OIL, WATER		✓ ⊗ ✓		* TIRES (Damage) (gauge)	
STANDARD FORM 19		✓ ✓ ✓						* CLEAN (As required)	
DD FORM 317		✓ ✓ ✓						TOOLS & EQUIP.	
TIRES		⊗ ✓ ✓						LUBRICATION	
I HAVE PERFORMED THE MAINTENANCE REQUIRED IN THE PREVENTIVE MAINTENANCE SECTION									
1ST OPERATOR					4TH OPERATOR				
James L. Botts									
2D OPERATOR					INSPECTED BY				
John N. Wales					J. B. Hooker (Mech.)				
3D OPERATOR					INSPECTED BY				
Homer P. Fine					S.F.C. B.T. Bracoe (Sect. Leader)				

DETACHED FROM DD FORM 110, 1 DEC 53

1 July 1961

Figure 17. DD Form 110 (Vehicle and Equipment Operational Record).

b. As a result of the study it was concluded that—

- (1) the existing system should be and can be modified or revised to achieve mandatory maintenance data reporting without placing additional burdens on the combat forces through simplification and streamlined elimination of certain existing forms and reports;
- (2) through the use of a multipurpose form, elimination of duplication of record keeping can be achieved and at the same time the form may serve as a source of data that can be analyzed and used to record true materiel deficiencies as compared with shortcomings on selected items of equipment; and
- (3) TAPER will eventually replace the existing Unsatisfactory Reporting System (AR 700-38).

c. Data generated through the use of the multipurpose form will enable the responsible technical service to make equipment improvements, increase reliability, decrease maintenance requirements, and improve performance.

d. Used to record maintenance replacement rates and correlate with supply data, the form will provide information from which repair parts requirements can be determined.

e. Other uses include—

- (1) reporting of modification accomplishments whereby users and national maintenance points will be able at all times to determine which items have or have not been modified and take necessary followup action; and
- (2) up-dating equipment record files. Important data can be accurately transcribed from the multipurpose form to the historical record maintenance on selected equipments.

f. Base on the findings of the study the DCSLOG has been directed to, "Revise as necessary the Army's current equipment record system in order to provide a simple, effective, standard procedure which will produce essential maintenance management intelligence and provide necessary controls for each successive level of command and supporting echelons starting with the equipment operator and his unit."

Section IV. REPAIR PARTS SUPPLY FOR ORGANIZATIONAL MAINTENANCE

192. Repair Parts Stockage

a. Units and organizations are authorized equipment by their TOE, Table of Allowance (TA), and/or Equipment Modification List. The initial prescribed load of repair parts necessary for organizational maintenance is listed either in appropriate DA supply manuals or in Parts I and II of the five-part technical manual for the equipment. As stated in AR 735-35, "Units or organizations authorized stockage of a prescribed load of repair parts will maintain the prescribed load of repair parts on hand or on order."

b. The initial prescribed load of repair parts for a new item of equipment is derived from an engineering estimate of the stockage required for organizational and higher echelon maintenance operations and is drawn up before the item is first distributed. It differs from the method of determining stockage of equipment that has been in service for some time as it is

not based on demand experience, but on expectation of demand. In practice, the prescribed load often exceeds or falls short of the actual maintenance needs of the equipment. Until the load is revised—a process that may take several years—the unit using the end item may be encumbered with an excess of slow-moving parts, while it lacks others with higher mortality rates. In certain cases, although no usage data are required at the organizational maintenance level, major commanders may direct using units and organizations to retain copies of DA Form 1546 (Request for Issue or Turn-In), to show demand data. When usage experience indicates that certain items are not required or that the quantity required is less than that authorized, the smaller quantity may be stocked. This practice is used infrequently and at present, a study is being conducted by the Army in an effort to determine new procedures by which more realistic initial loads of repair parts can be developed.

193. Repair Parts Supply Procedure

a. When a using unit first receives an end item of equipment, it should record the item in its property records by make, model, and serial number. It should then obtain Parts I and II of the technical manual issued for that end item and other applicable technical publications such as lubrication orders. If these publications have not been issued with the end item, they should be requisitioned at once. The initial prescribed load of repair parts, as shown in the applicable technical manual, should then be requisitioned from the supporting maintenance or supply activity. If the using unit encounters any problems either in properly identifying the equipment or in obtaining the appropriate manuals, it should request assistance from the supporting maintenance activity.

b. When a repair part is required for replacement on an item of equipment assigned to the using unit, the parts specialist or maintenance sergeant, upon verification by the unit mechanic, takes one or more of the following actions:

- (1) If the item is stocked, he issues it to the unit mechanic and requests replenishment of the prescribed load from the supporting maintenance activity.
- (2) If the item is authorized for replacement but not stockage at the organiza-

tional level he may requisition the part.

- (3) If replacement is not authorized at the organizational level, arrangements will be made with the direct support unit for evacuation or on-site repair or replacement.
- (4) If the replaced repair part is designated in the appropriate manual as a recoverable item, it will be turned into the supporting maintenance activity in accordance with technical service instructions.

c. In certain cases, as discussed in AR 711-16, direct support units and technical service activities at installations may establish and maintain a direct exchange stock of certain serviceable repair parts and components, such as starting motors, generators, carburetors, fuel pumps, and brakeshoes, which are not stocked in the using units or which are temporarily in short supply. The list of direct exchange items is prepared jointly by the responsible supply and maintenance sections subject to the limitations established by the chiefs of the technical services and the major commander. The list is distributed to all units authorized to use direct exchange repair parts procedures. Organizational representatives may then physically present unserviceable parts on the list to the direct support unit and exchange them for serviceable parts.

Section V. THE ORGANIZATIONAL MAINTENANCE INSPECTION SYSTEM

194. Standards

a. The maintenance inspection system is one of the most vital elements of Army maintenance management. Periodic and systematic inspections permit commanders to determine the relative serviceability of equipment and the effectiveness of maintenance support. They also allow the technical services to monitor the maintenance program under their technical supervision and to assist in correcting deficiencies in equipment or in the maintenance system itself.

b. All maintenance inspections of equipment are conducted under command authority and are used by the commander to determine—

- (1) the serviceability and operational readiness of a unit's major items of equipment;
- (2) the adequacy and effectiveness of organizational and/or supporting maintenance operations, including repair parts supply;
- (3) the proficiency of unit maintenance personnel;
- (4) additional maintenance requirements disclosed by the inspections.

To keep himself clearly informed of these conditions, the commander must establish carefully defined inspection standards and make certain that they are used by any subordinate

personnel in conducting inspections. These standards should take into account local conditions, including the capabilities of the personnel, the level of their training, and the adequacy of their tools and equipment. Although the commander should require personnel to comply strictly with prescribed inspection instructions, he must always be ready to modify these procedures if the situation demands it. Inspections should be spaced so as to provide sufficient preparation time and conducted only as often as is necessary to enable the responsible commander to determine the condition of maintenance in the unit.

195. Command Inspections

a. Command inspections are different from command maintenance inspections in that the commander participates personally. Command inspections are of two types—formal and informal.

(1) *Formal command inspections.* The formal command inspection is conducted by the commander, often with the assistance of an inspecting party composed of technical assistants and various members of his staff. The inspection covers all equipment and personnel assigned to the unit and is conducted at intervals prescribed by the unit commander.

(a) One of the purposes of the inspection is to make sure that equipment and supplies are being used correctly and economically, in compliance with organizational maintenance principles set forth in pertinent Department of the Army publications. The inspections cover the adequacy of supply of parts and equipment, the efficiency and completeness of preventive maintenance, the prevention of equipment abuse, the adequacy of personnel training and discipline, and compliance with prescribed maintenance procedures and regulations. Although detailed technical examinations of equipment are impractical in command inspections, the inspections should be thorough

enough to reveal major faults and areas of neglect or carelessness. Various operational tests generally are made to check the maintenance condition and mission readiness of major items of equipment and the proficiency of the troops. The inspection should reveal any need for a change in policy or methods of instruction or for additional training. Commanders should also recognize outstanding performances by maintenance and operating personnel deserving of commendation.

(b) The formal command inspection requires advance notice and a set procedure. The thoroughness of the inspection requires considerable time and preparation.

(2) *Informal command inspections.* The informal command inspection is also characterized by the personal participation of the commander. It usually is given without prior notice and is made at any convenient time and place. It involves no set procedure but usually is conducted each day or week on a different type of the unit's equipment. Thus, over a period of time the commander personally inspects the largest part of the unit's equipment. On these inspections the commander may be accompanied by assisting personnel, and often he may find it desirable to use checklists similar to those used in formal command inspections. Informal command inspections are designed to provide firsthand information on the day-to-day condition of equipment and the maintenance proficiency of personnel. Improper operating procedures and poorly functioning equipment can be quickly discovered and corrected. Proper preventive maintenance techniques are emphasized.

b. Although the commander personally conducts and participates in command inspections, he may be handicapped by limited technical knowledge of equipment inspected. To meet

this problem, the Army has prepared tabulations of preventive maintenance (PM) indicators and distributed them via various publications. These tabulations are checklists of specific technical inspection points for items of equipment; they indicate, but do not completely establish, the preventive maintenance status of the equipment. Indicators are intended for the use of the nonspecialist and particularly for the commander. They are not a substitute for proper officer training in maintenance; they are only a valuable maintenance aid. They should not be used merely as mechanical checkoff lists, but as indicators of the maintenance condition of a unit or particular piece of equipment.

196. Command Maintenance Inspections

a. Annual command maintenance inspections are conducted overseas and in the CONUS on at least 50 percent of all major items of Army, Army Reserve, ROTC, and National Guard materiel and related equipment employed by using units and activities and their supporting organizational and field maintenance shops. The inspections are conducted by maintenance teams that are designated by major commanders. The teams are composed of technical service personnel from the major command or from corps or division levels, or installations. They may be augmented by personnel from direct support maintenance units or from supporting fixed field maintenance activities of the organization being inspected, or by other qualified maintenance personnel.

b. Command maintenance inspections are intended to make available to commanders, and chiefs of technical services, a formal means for determining—

- (1) serviceability, proper usage, and operational readiness of a unit's major equipment;
- (2) the adequacy and effectiveness of organizational and/or field maintenance operations;
- (3) the efficiency of repair parts supply procedures directly supporting maintenance operations;
- (4) the proficiency of unit maintenance personnel; and
- (5) additional maintenance and exchange requirements derived from deficiencies disclosed during the inspection.

c. Letter inspection reports are prepared by the officer in charge of the inspection team and are usually submitted directly to the headquarters responsible for performing the inspection; copies are furnished to the unit or activity commander. Normally, critiques are held before the formal report is transmitted. At this time the commanding officer of the unit inspected is given opportunity to make any comments he considers appropriate. Followup inspections are completed within 60 to 180 days on any equipment or maintenance and repair parts supply activities found to be unsatisfactory.

d. Shop operations and supporting supply activities are rated on a percentage basis, ranging from "Unsatisfactory" (70 percent or below) to "Superior" (94 percent or above). The narrative form of the inspection reports also allows for an adjectival maintenance rating for each category of technical service equipment. These ratings are prescribed in the appendixes to AR 750-8 and are based primarily on a determination as to whether the deficiency reported is major or minor.

PART FIVE

MAINTENANCE IN THE FUTURE

The material presented in this Part of the manual offers an imperfect forecast of the future based on what we now think the future will be. This material is included in the manual to stimulate thought about—and hopefully, to prepare us to cope with—the ever increasing responsibilities of modern Army maintenance management.

CHAPTER 18

MAINTENANCE CONCEPTS IN THE NUCLEAR ERA

Section I. GENERAL

197. Scope

a. Examined here are some of the major problems that may confront Army maintenance in the 1960–70 time frame and some of the changes in maintenance concepts, organization, and equipment that probably will be necessary as a result of these problems. Major logistics problems are posed by a nuclear era in which both strategic and tactical nuclear weapons will be available in quantities sufficient to wage war on any scale. Certain changes in logistics doctrine and organization currently under consideration are necessary to strengthen the Army's ability to fight in both general and limited nuclear war environments.

b. For logistics planning purposes, Army planners generally have split the 1960 decade into two periods: the Mid-Range period covering 1960–64; and the Long-Range period, encompassing 1965–70. In the Mid-Range period, the Army will depend primarily on present day equipment; meanwhile, revisions will be made in maintenance technology and concepts that will provide the Army with more effective support in the Mid-Range period and also lay the groundwork for new equipment and maintenance concepts for the Long-Range period. During the Long-Range period new families of weapons and support systems will be intro-

duced to the operating forces; this will have a major impact on maintenance operations. Currently, the Army is defining and implementing logistics programs for the Mid-Range period; it is also preparing the logistics plans that will subsequently become the programs for the Long-Range period.

198. The Challenge and the Need

a. United States national policy is committed to the development of a force sufficiently powerful to deter aggression. In support of this policy, the Army must have forces-in-being, backed up by a strong reserve, that are prepared to deal with the whole broad spectrum of warfare—ranging from limited conventional or nuclear wars to all-out general nuclear war.

b. The Army's ability to deter or wage any type of warfare depends not only on powerful military forces-in-being but also on a potent and responsive logistic structure. Logistics will be vitally important to the Army of 1965. The nuclear era poses new operational and logistics problems, but the Army's basic requirements for timely and adequate logistic support remain unchanged. Necessary changes will be made in the logistics structure to provide the caliber of support required for the Army.

Section II. NUCLEAR WEAPONS AND ARMY MAINTENANCE

199. Magnitude of the Problem

To deter aggression the Army must be prepared to fight a general or unlimited nuclear war which would involve the use, or threatened

use, of high-yield strategic weapons. Such a war would involve virtually unrestricted military objectives. In addition, the Army must be prepared to deter and, if necessary, wage

limited nuclear warfare; this type of conflict, with restricted military and political objectives, may involve employment of tactical nuclear weapons. In sum, both operations and logistics systems must be developed that will function effectively in a global nuclear war, a limited conventional war, or a limited nuclear war.

200. Possible Effects of Nuclear Attacks on the Army Maintenance System in CONUS

a. In the event of a nuclear attack on the United States, the maintenance component of the Army's logistics system would be faced with two basic problems. First, it would have to sustain itself against an attack that would presumably include as primary and secondary targets the Army's depot system and major Army installations, including fixed field maintenance shops. Secondly, having survived the attack, the Army's maintenance system would have to respond to the exacting maintenance requirements of the Army.

b. Although the Army's troop and logistic installations in CONUS will necessarily be affected by the nature and success of the total attack on CONUS, the Army is expected to have a higher survival and more rapid recovery rate than the Nation at large because of the Army's greater dispersion. Most depot and field maintenance shops are not in or near prime target cities, and they offer only solitary, relatively unprofitable, targets.

c. Those maintenance facilities and units that do survive may find that transportation will present one of their chief difficulties. Rail nets that converge on hub cities may be out of action for considerable lengths of time; highways and airfields are less vulnerable and more readily rehabilitated. The latter two transportation systems probably will be relied on initially to fulfill maintenance transportation requirements. Residual radiation in transportation zones will have a considerable impact in determining which routes or methods of transportation may be most suitable. In many instances, it may be desirable to use air transport to avoid contaminated terrain when traveling between a maintenance unit and a user or supply source. Communications systems will also be vulnerable; rapid repair operations and alternate systems will be necessary if the main-

tenance and supply systems are to operate effectively in CONUS under a nuclear attack.

d. Until the Nation's heavy production centers can be returned to operation and new equipment produced, the surviving depot maintenance system may be called on to meet military supply needs by extensive overhaul of reparable reserve stocks and damaged assets. Also, both depot and field shops will be burdened with a heavy load of regular maintenance on equipment, since all units will have to operate their equipment at peak performance in the event of an attack.

e. The Army maintenance system in CONUS and the commands that it supports not only will have their assigned military missions to carry out, but it is expected that they will have to fulfill certain civil defense requirements.

201. Possible Effects of Nuclear Warfare on the Army Maintenance System Overseas

a. Because of their high damage ratios and the ease with which they can be employed, tactical nuclear weapons of varying yields more likely will shape the nature of any future overseas combat situation. The variety and mobility of delivery systems makes tactical nuclear weapons readily deployable against targets of opportunity as well as against fixed targets.

b. The weapon yields and the use of fall out will greatly condition the ability of maintenance units to survive attack and then carry out their missions. Maintenance groups can materially improve their resistance against nuclear attacks by applying such basic protective techniques as wearing proper clothing, washing down equipment, using detection devices, and employing natural terrain cover against thermal and blast effects.

c. In a limited nuclear conflict waged overseas, both the enemy and our own forces might restrict their weapons to the combat zone, thus leaving the CONUS logistics system untouched and capable of supporting overseas operations. However, in a general nuclear engagement, which would permit no sanctuaries for either side, the maintenance system overseas may be subjected, directly or indirectly, to several obstacles. Destruction of supply depots in CONUS and ports both in the United States and overseas may have a severe effect on the movement of supplies overseas. Although the

use of alternate secondary ports and beach landings may reduce the threat to shipping installations themselves, it is expected that there will be a considerable wartime cargo loss in transit until the enemy submarine menace can be suppressed. Finally, the use of nuclear weapons will create an oversea battle area in which dispersal, depth, and mobility will be prerequisites to combat effectiveness.

202. The Army Mobility Objective

Mobility has long been a fundamental precept of warfare; it has been made all the more urgent by the necessity to be able to disperse as a protection against nuclear attack and to be able to regroup rapidly when concentration is required. Optimum mobility in combat is by no means easy to achieve in either an operational or logistics sense, and it certainly does not simply connote an Army's ability to remain in a state of perpetual motion. The relationship of logistics to mobility in combat is clear. The unbroken line of supply concept is nullified by nuclear conditions. This situation will be greatly magnified in nuclear combat. The lines of communication, including supply, may be subjected to constant interruptions from nuclear damage to railroads and bridges, from attack by enemy forces who may have staged a breakthrough by use of nuclear weapons, or from enemy guerrilla forces operating behind the lines. Compounding the logistics support problem will be the dispersal pattern required of major forces. A division in World War II usually operated on a 5-mile front with a depth of about 30 miles. Cur-

rently, a division front is about 10 miles with a depth of 30 miles; by 1965-70 it is expected that these distances will be even greater. Additionally, many airborne units may be dropped into isolated areas, or ground units may find themselves operating independently for extended periods. In sum, the problems of providing logistics support in a nuclear environment will vastly exceed those encountered in World War II and the Korean War.

203. Requirements for Modernization

a. The use of nuclear weapons as a standard element of the general and limited war arsenal has posed a number of problems for the Army maintenance system as it enters the 1960-70 decade. The requirement for dispersal and maximum self-sustenance of both combat and support units has necessitated not only a reappraisal of operational and logistics organization but also a reexamination of maintenance concepts and technology. The nuclear era has also created a demand for new or improved weapons and support equipment.

b. The Army maintenance system must assist R&D in designing end items, components, and test equipments that are both reliable and readily maintainable. It must insure that the necessary skilled technicians, repair parts, tools, and test equipment are available at the right time and in the right place to carry out the maintenance mission. The Army maintenance system must be organized in a manner that is compatible with the total logistics organization and that will enable it to keep combat and support equipment in operation.

Section III. RELIABILITY AND MAINTAINABILITY

204. Interrelationship of Reliability and Maintainability

Reliability and maintainability cannot always be compatibly designed into an end item or a component. The configuration of some missiles and other major end items of equipment provide for placement of certain vital components or parts in inaccessible, interior locations in order to improve shock-resistance and thus the reliability of the overall weapon system. Such configurations may result in complicating the maintenance task by necessitating more time, tools, or skills re-

quired to repair or replace the isolated component when it fails. On the other hand, some measures taken to improve maintainability may have an adverse effect on reliability.

205. Reliability

a. Despite the problems that it entails, more emphasis must be given to reliability in designing Army equipment. In nuclear combat, Army forces will have to operate with austere logistics. Support and troop units and their equipment may be cut off from supplies and maintenance services for extended periods of time. The effectiveness of a unit may greatly

depend on the reliability of its equipment. The achievement of longer-lived end items and more equal component lives will demand the attention of research and development designers as well as maintenance engineers and technicians. Maintenance agencies will be expected to develop more sophisticated and thorough methods for measuring potential failures and for assessing maintenance requirements and capabilities relative to reliability.

b. The growing complexity of military equipment with a multitude of components has been felt keenly in the reliability area because the overall reliability of any complex assembly equals not the *average* but *product* of the reliability of its components this is illustrated by the reliability formula:

$$P_{\text{overall}} = P_1 \cdot P_2 \cdot P_3 \cdot \dots \cdot P_n$$

where $P_1, P_2, P_3 \dots$ are the reliabilities of the (n) components of an assembly or system. Applying this formula to even a simple missile consisting of 100 components, each having a 99 percent reliability, the missile system would have an overall reliability of only 36.5 percent. Thus, about two out of three missiles would fail—a most unsatisfactory performance record.

c. Studies conducted recently offer an example of reliability standards and maintenance criteria projected for the 1960s.

- (1) During Phase I, ground vehicles should have a 90 percent probability of completing the following mileages in a military environment:
 - (a) *Wheeled, tactical vehicles.* 10,000 miles without field maintenance and 20,000 miles without depot maintenance;
 - (b) *Tracked vehicles.* 2,000 miles without field maintenance and 4,000 miles without depot maintenance.
- (2) During Phase II, ground vehicles should have a 90 percent probability of accomplishing the following in a military environment:
 - (a) *Wheeled, tactical vehicles.* 25,000 miles without field or depot maintenance;
 - (b) *Tracked vehicles.* 5,000 miles without field or depot maintenance.
- (3) These particular objectives represent

a considerable advance in reliability standards. It is hoped that eventually a gas turbine or other simple engine will be developed for military use, thus creating even greater improvements in reliability and maintainability. Another problem is the economic necessity for the Army to use, when possible, military vehicles or components that are simply adaptations of commercial items. The process of making adaptations to military usage is termed environmental engineering, and efforts are being made to educate the automotive industry more fully in this area. The Army is attempting to provide industry with detailed maintenance criteria that should be followed in developing commercial-military vehicles for introduction to the field in the late 1960s.

- (4) In the automotive field, extensive failure data has been compiled to determine the probability of vehicle survival without depot maintenance. By isolating components causing an overall low reliability, Army and industry engineers hope to be able to eliminate critical trouble spots by substituting modifications or new designs that will improve reliability.
- (5) Extensive work is being conducted in conjunction with industry on reliability of missiles. The missile reliability problem, which is shared by the Air Force and Navy, is especially acute; this is due to not only the hundreds of components used in a single missile system but also to the multiplier effect of component failures. Major strides have been made in reliability. In both liquid and solid propellant missiles the emphasis necessarily is on preventing in-flight failure. To minimize the ground maintenance burden, efforts are being made to reduce the failure rate when missiles are in storage or on site.

d. Several programs are in being to attain corresponding improvements in reliability on other Army equipment. These programs have taken varying forms:

- (1) A family of small, lightweight military engines with greater end item and component reliability is being developed. A significant feature of this new engine family is that the six engines use only some 800 parts, as opposed to the previous family of 78 makes and models, which used 23,000 parts. This interchangeability-of-parts element reduces stockage and also improves overall performance capability by decreasing downtime resulting from unavailability of parts. The reliability factor as such refers only to the probability that an end item will perform as prescribed, not to its ease of maintenance. However, an item is more reliable in a commander's eyes if it can be repaired easily than if it fails less often but cannot be readily repaired when it does fail.
- (2) In the communications - electronics field, more rugged, reliable equipment is being produced. Increased reliability of Signal equipment has been achieved by application of such techniques as encapsulation, printed circuits, die casting, and micromodularization.
- (3) In another area attempts to improve the reliability of helicopter components is under study. Presently, the number of flying hours for helicopters is very low (varying from 250 hours to a high of 2,500 hours) because of the required overhaul frequency on dynamic components such as engines and rotor blades. The objective is to achieve a minimum of 1,200 hours for all components; this would bring about considerable savings in maintenance costs and labor as well as decreasing downtime.

206. Ease of Maintenance

a. General. In the future, ease of maintenance will assume increasing importance as a maintenance criterion. The nuclear battlefield with its requirements for unit mobility, dispersion, and self-sufficiency, will sharply curtail the time available for evacuation and repair.

In addition, there will be the necessity for doing considerable combat zone repair at lower echelons using relatively unskilled personnel. These two pressing elements of time and skills place a premium on ease of maintenance for the 1960-70 family of equipment. Ease of maintenance can be achieved in a number of ways. Modularization, standardization, accessibility, and simplified testing methods and devices all can contribute to simple and expeditious repairs. Of these techniques, modularization and simplified "go, no-go" testing devices are perhaps the most recent developments. Accessibility and standardization, which have been applied as maintenance criteria for several years are currently applicable doctrine.

b. Modularization.

- (1) Modularization is defined as a system of interconnected functional units designed and constructed to facilitate removal and replacement. Modules are not limited to any fixed size or weight but are ordinarily constructed so that they can be easily handled by one man. The chief advantage of modularization is that replacement can be made readily, resulting in less downtime and facilitating removal to higher echelons for repair. A group of modules designed for easy replacement can also be arranged so as to facilitate prompt isolation of faults by pluck-out, plug-in techniques. Modularization is employed particularly in electronics equipment. Here it provides for microelements to be united and protectively encapsulated, thereby improving the equipment's ruggedness and reliability. Various encapsulation methods used to date have been given good protection against heat, water, shock, and dust. The potentialities of modularization are also being explored in other areas, including small arms, artillery, and automotive equipment.
- (2) In an effort to improve reliability and reduce weight and cube of electronics equipment, the Army has intensified its microminiaturization program. The present standard "handy talky" has an electronic parts density of about 8,000

parts per cubic foot. The new helmet radio has been designed with an electronic parts density of over 50,000 parts per cubic foot—an improvement of more than 600 percent. This increase in parts density through micro-miniaturization complicates some repair tasks, but this disadvantage is usually nullified by using micro-miniaturization in connection with modularization. By using modules, the microminiaturized units can be replaced and thrown away rather than repaired. Miniaturization also means that less space and transportation will be required for parts supply.

c. Throwaway Concept. The throwaway concept presumes that, upon failure of the assembly, component, module, or end item, it will be discarded; no repairs will be made. This concept of disposal-at-failure is not especially radical. Light bulbs and spark plugs are common examples of reparable items that are discarded because it is either inconvenient or uneconomical to repair them.

(1) There are variations to throwaway. It is not necessary to treat every part of a throwaway end item as disposable. Consideration is being given to designing a one-half horsepower engine for which replacement will be made on such accessible high-mortality items as points, condensers, and gaskets. The total end item will be discarded completely, rather than repaired, when major overhaul is necessary. In this case, only certain components would be thrown away at first, but eventually the end item itself would be discarded. In other instances, certain components might be repaired instead of thrown away. A throwaway sight for 3.5 rocket launchers is in use and testing of the throwaway method as applied to telescopes, binoculars, and watches is now underway. In the electronics field, particular emphasis is being given to throwaway modules.

(2) One major advantage of the throwaway concept lies in its economy. The

reduction of line items of repair parts can be considerable, e.g., the use of a throwaway watch could eliminate 375 line items of repair parts. This reduction, in turn, cuts costs in procurement, stockage, and distribution. Another important benefit of the throwaway concept is that it serves to reduce the technical skills required at field and depot levels. Replacement and throwaway shortens downtime, and it also can improve reliability by reducing excessive and damaging maintenance operations.

(3) Like any other concept, throwaway cannot be considered a cure-all for Army logistics problems. It requires an extensive end item stockage and distribution system whose cost must be weighed against savings in repair parts. Throwaway, as well as simple replacement techniques, can cause severe logistics problems in the field. The development and application of the throwaway concept depends on a careful economic analysis and appraisal of its consequences in various combat situations.

d. Improved Testing Systems. The development of more effective testing systems is essential to Army maintenance in the future. The necessity for making prompt repair or replacement in the field, often using relatively unskilled personnel, places a high priority on the availability of simple, accurate, and rapid test equipment. Current and projected new equipment has become so complex that visual inspection has little value in isolating faults. Much of the current test equipment is often technically ineffective or too unwieldy for the job at hand. Army and industry maintenance engineers are trying to develop improved types of test equipment and end items designed to accommodate these new testing systems, with special consideration being given to the simplified "go, no-go" type of testing.

(1) Acute testing problems on complex electronics equipment confront Army engineers, consequently great stress has been placed on the development of automatic test equipment.

- (2) The variety of testing missions necessitated by weapon system complexity has led to the development of many different types of test equipment, much of which is delicate, complicated, and hard to repair. At present, the Federal Stock Catalog contains over 10,000 end items of test equipment. There are over 1,000 test equipments directly applicable to missile systems alone.
- (3) Since 1955 the Army, acting in conjunction with industry, has been attempting to standardize as well as improve their test equipment. Modularization, interchangeability, self-calibration, and integration techniques have been applied in an effort to enhance the status of this oft-neglected aspect of Army maintenance.
- (4) The Army now has under development a Multipurpose Automatic Inspection and Diagnostic System (MAIDS). This system is designed to provide the accuracy in inspection capable of pinpointing a defective part, component or assembly without disassembling the item.
 - (a) One of the major problems involved in the maintenance of today's highly complex equipment is the diagnosing of malfunctions. Modern main-

tenance techniques have adopted simplified test procedures utilizing multitest instruments to analyze the performance and/or serviceability of complex equipment in a minimum of time to the ultimate aim of reducing the requirements for highly skilled technicians and reduce downtime on highly complex equipment to an absolute minimum.

- (b) MAIDS is a form of automatic sequential checkout system. By automatically controlling the functions of the multitest instruments which make up this system it is possible to expand their operation far beyond limitations imposed by manual controls. Thus a large number of intricate test sequences can be controlled by semiskilled technicians. By use of transducers, operating characteristics such as force, light, heat, pressure, flow, and motion stimuli are compared to norms programed into the digital computer. Any variations within established tolerances are printed out and then analyzed by personnel competent in the interpretation of the charted information. This works on the same principle as the "go no-go" gages.

Section IV. REVISIONS IN ORGANIZATION TO MEET THE CHALLENGE OF THE NUCLEAR ERA

207. Organization for Maintenance Support Operations in Future Combat

a. Basic Problems and Concepts. To a great degree, logistics organization is determined by the tactical organization which, in turn, will be conditioned by the nuclear environment in the 1960s. This environment does not change the basic mission of maintenance to furnish prompt and effective support to operating forces; however, it greatly compounds the difficulty of carrying out this mission and necessitates a total reappraisal of the existing maintenance and logistics organization.

b. Effects of Nuclear Warfare on Army

Maintenance. The urgent requirement of strategic and tactical mobility will create a situation in which combat units generally will be dispersed for protection against nuclear attack while disengaged from the enemy in pre-battle staging areas, or while moving into combat position. When a unit moves into combat, it is likely that varying degrees of concentration will be necessary for purposes of massing optimum firepower or controlling a key area. This fluctuating pattern of dispersal, concentration, and rapid movement alone will pose a severe support problem for maintenance. Even when a unit is not in action its equipment will not be conveniently grouped for repair. Al-

though units may concentrate for battle, even emergency maintenance repairs have always been difficult to execute during actual combat. Traditionally, maintenance does its major damage repair immediately after combat. In a nuclear war, new problems will be added by the rapid, dispersed, postbattle movement out of target areas. Heavy equipment will be abandoned, perhaps in a guerrilla infested area, and the combat units once again will be dispersed. There may be heavy nuclear damage to transportation links and wire communication channels. Unconventional warfare or enemy breakthrough on a fluid front may cut off units and isolate heavy equipment abandoned for evacuation. These hazards will seriously disrupt normal methods of providing maintenance support to units. Traditionally, maintenance support units have kept in close, continuous contact with their customers and have promptly fulfilled demands for repair or replacement on-site or for evacuation to the rear. These practices will be difficult to execute under nuclear combat situations and the response to maintenance requirements will be subject to far greater delay and risk than in previous conflicts.

c. Possible Approaches. Several approaches to the problem of providing maintenance support are under consideration by various Department of the Army agencies:

(1) The combat unit loads of duplicate end items and/or repair parts and components might be increased so that units will be self-sustaining for longer periods. This is a support method used rather extensively and successfully by the Navy on combat vessels where each critical item of equipment has a standby duplicated elsewhere aboard ship.

(a) Self-sufficiency is one objective in military planning, but to a large extent it is countered by the more important goal of mobility with its emphasis on supply austerity. Armies of the 1960s cannot go to battle with a cumbersome supply train and attached auxiliary services. Increases in a basic combat load of end item would be practi-

cable only if the items were themselves prime movers (e.g., additional vehicles) for which there was an economic use, or if they were small enough to be insignificant in the total load. The most profitable means of improving self-sufficiency from a maintenance standpoint lies rather in reassessing current methods of establishing repair parts loads at use levels.

(b) Studies now being conducted indicate that greater self-sufficiency might be obtained without a loss of mobility by redistributing present total loads of repair parts to those parts whose criticality and expected shortage warrant higher stockage. While such a reappraisal of loads and computation methods appears desirable, it is still apparent that the degree of self-sufficiency attained in the future will not be enough to obviate the need for maintenance support. Perhaps the maintenance supply reaction time can be extended somewhat, but ultimately there must be an effective logistics response to user demands.

(2) Logistics trains might be employed using off-road vehicles equipped with supplies, repair parts, and repair shops to service combat unit needs with scheduled replenishment and repair visits. These trains could be armored and accompanied by a screen of reconnaissance vehicles and tanks. Such a mobile logistics task force again has its parallel in the familiar Navy service squadrons of supply ships and tankers protected by escort carriers, cruisers, and destroyers. The logistics train concept is receiving much consideration because of its inherent mobility. Operating on a scheduled, predetermined routine when feasible, it could eliminate the need for much communication and the consequent risk of communication breakdowns. With a protective screen in guerrilla infested terrain, a logistics

train might be able to function well to service units and evacuate equipment. Its chief disadvantage lies in its own concentrated mass which offers a prime target.

- (3) A third system is that the maintenance organization could be built around general support units in the rear and direct support units with, or close behind, combat forces. The direct support units could have subsidiary mobile maintenance teams capable of quick reaction to specific demands by combat units.

d. Current Organizational and Field Maintenance Doctrine for the 1960s. The structure of maintenance activities in the field prescribed for at least the early 1960s does not differ radically from that employed in the late 1950s.

- (1) *Organizational maintenance.* First and second echelon maintenance, in particular, has been subjected to few major changes. Specialists assigned to using units will continue to perform prescribed second echelon maintenance and supervise the first echelon and preventive maintenance being performed by the equipment operators. Replacement and minor on-site fabrication will characterize most maintenance accomplished at organizational levels in an effort to reduce the maintenance skill requirements at the user units.
- (2) *Direct support maintenance.* Direct support maintenance units (DSU's) will be disposed laterally and in depth to provide very close effective support to the using units. DSU's will provide primarily third echelon maintenance by on-site repairs or replacement, delivery of parts to using units, and technical assistance. These units are expected to provide direct exchange service by delivery to the using units requested serviceable items for unserviceable assemblies, components, and end items. They will either evacuate unserviceable equipment or arrange for its evacuation from the using units. Evacuation will

be made to a general support unit or a salvage collection facility (bone-yard) for removal of required usable or economically reparable assemblies and components. Evacuation will be especially important because in many cases a unit will have to abandon its inoperable equipment owing to the rapidity of its own movement or to the delay in bringing up maintenance support.

- (a) Direct support maintenance units will ordinarily support the same tactical units throughout an operation although they may be called on to assist another DSU or to assume another's mission if it is destroyed. Thus, a DSU must be at least as mobile as its combat customer; it will be completely ground mobile and, when practicable, air transportable. The development of off-road vehicles will greatly improve ground mobility of DSU's in the 1960s, but the problem of air transport is more acute. The employment of personnel and cargo helicopters for maintenance and supply purposes is being carefully considered.
- (b) As part of the mobility concept, it is expected that mobile maintenance teams attached to a DSU will make most repairs at the point of breakdown or abandonment.
- (3) *General support maintenance.* Fourth echelon maintenance will be provided by general support maintenance units. They will be organized to provide backup support to the direct support maintenance units and will possess sufficient skilled personnel, parts, and maintenance exchange and replacement stocks to accomplish all echelons of maintenance authorized in the theater except fifth echelon component and end-item overhaul. It is expected that general support units will have approximately a 50 percent mobility in organic transportation. Additional transportation will be provided, as needed, from outside sources.

e. The Basic Problem. The problem is to weigh minimum feasible reaction time of present-type support units to fill maintenance demands of combat units under nuclear warfare conditions against minimum feasible time cycle of automatic maintenance service and replenishment afforded by a logistics train—with a control factor being the maximum self-support capacity (measured in time) of the combat units themselves. The optimum maintenance organization to solve this problem of providing the most effective and efficient support doubtless will be a combination of approaches now in being or under study.

f. Depot Maintenance. Current Department of the Army planning calls for continuing depot maintenance on end items and components in CONUS shops. It is anticipated that the increase in reliability, coupled with new maintenance concepts such as modularization and throwaway, will lead to a corresponding decrease in depot maintenance. It is apparent that the entire maintenance echelon structure will come under increasing study over the next few years, and some radical revisions to the current five-echelon system may be made to meet more effectively the maintenance requirements in a nuclear warfare environment.

g. Supply Organizations for the 1960s in Support of Maintenance. Theater supply organization will be compatible with the maintenance organization. Supply depots will insure an orderly flow of end items, repair parts, and maintenance supplies to the various maintenance echelons. Overseas and in the United States, dispersal of stocks will be emphasized.

In combat theaters, it is expected that most supply depots or stockage points will contain supplies and repair parts of several technical services. Thus the objective in most cases will be to have dispersed general stocks rather than concentrated single stocks, since the latter system would be vulnerable to nuclear attack.

208. Problem Areas

The future effectiveness of maintenance will depend greatly on the skills and judgments of the personnel operating the system. The required skilled personnel will be drawn largely from a pool of officers and men with native technical ability. This supply is obviously limited, since only a relatively small percentage of the populace has a high technical aptitude. Any wartime increase resulting from expanded conscription will be offset by the increased requirements for logistics personnel. Furthermore, the possible necessity of using forces-in-being to wage general war until mobilization is in full motion or waging a limited war with only partial conscription places a heavy demand on existing maintenance units. To keep pace with the dynamic evolution taking place in technology and warfare, the maintenance system will have to become more mobile and capable of providing support to combat units more readily. Maintenance planning during the early design phases and subsequent development of new equipment will have to be applied with even greater intensity than heretofore. The Army maintenance system cannot afford to stand still if the Army is to fulfill its national security mission.

APPENDIX REFERENCES

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FM 38-1	Logistics Supply Management	15-420	Army Inspection and Quality Control Council
FM 101-51	Department of the Army Planning and Programming	15-470	U.S. Army Maintenance Board
		35-252	Consumer Funding, Transactions With Army Stock Fund
2. Technical Manuals		35-273	Accounting Policy and Procedures for Intragovernment, Intradefense and Intradepartment Transactions
TM 9-2810	Preventive Maintenance, Supply, Inspection, and Training Procedures, Tactical Motor Vehicle		ACMS Accounting for Installation Programs
3. Army Regulations		35-300	Auditing Service in the DOA
1-11	Army Management Structure	36-5	The Budget System
1-24	Army Management Doctrine	37-1	Financial Management Plan
1-50	Performance Analysis	37-5	Administrative Control of Appropriations
1-60	Management Improvement in the DOA	37-20	Working Capital Funds—Army Stock Fund
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1-110	Contracting for Management Advisory Services	37-61	Return of Materials, Supplies and Equipment to the Army Stock Fund
1-200	Inspections and Staff Visits	37-65	Responsibilities for Installations and Activities Financed by the AIF
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10-5	Department of the Army	37-108	Administrative Motor Vehicle Management
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10-8	Zone of Interior Armies and the Military District of Washington	70-20	Commercial and Industrial Type Activities
10-50	Special Command Relationship within CONUS		Military Publications, DA Publications—Preparation, Coordination and Approval
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700-5	Organization and Operation of Inventory Control Points	715-20	Procurement Inspection and Quality Control
700-11	Reduction of Equipment Requirements	715-30	Local and Regional Purchase of Civilian Type Items
700-12	Control, Supply, and Positioning of Materiel	725-8	Preparation and Processing of Electrical Accounting Machine Punched Card Requisitions and Related Supply Documents
700-17	Component Items of Equipment Assemblages	725-55	Order and Shipping Time
700-18	Repair Parts Allocation and Allowances	725-768	Supply and Maintenance Support Provided by Army Aircraft Field Maintenance Shops
700-19	Provisioning of Repair Parts		Supply Support of Oversea Organizational and Field Maintenance
700-21	Repair Parts Liaison Program	730-30	Army Pricing Policy
700-34	Inventory, Utilization, Redistribution, and Retention of Production Equipment	735-7	Code Pattern for Accounting and Reporting
700-37	Guided Missile Component Evaluation Data Report	735-15	Supply Procedures for TOE units Organizations and Non-TOE Activities
700-38	Unsatisfactory Equipment Report	735-35	Financial Inventory Accounting—General Principles and Policies
700-39	Electronic Failure Report	735-60	Concept of Maintenance
700-41	Unsatisfactory Report	750-1	Major Overhaul Policy and Program for Oversea Commands
700-51	Logistics Responsibilities	750-4	Organization, Policies, and Responsibilities for Maintenance Operation
700-70	Parts Requirements, Procurement, Stockage and Issue	750-5	Maintenance Planning, Allocation and Coordination
700-1300-8	Malfunctions Involving Ammunitions and Explosives	750-6	Command Maintenance Inspections
700-2300-1	Motor Vehicles	750-8	Maintenance Responsibilities of the DOA and the DAF
700-6500-15	Reporting and Processing Materiel Complaints	750-11	Maintenance Readiness and Field Maintenance Costs (RCS CSGLD-931) Maintenance Readiness of Representative Critical Equipment (RCS CSGLD-932)
701-5	Assignment of Responsibilities for Logistic Functions	750-15	Contract Technical Services
705-5	Army Research and Development		MAP Overhaul and Maintenance Program
705-6	Type Classification of Materiel	750-22	Use of Controlled Cannibalization as a Source of Low Mortality Repair Parts Supply
705-9	Technical Committee Functions	750-28	
710-25	Unobligated Army Stock	750-50	
710-45	Supply Control Procedure for Minor Secondary Items and Repair Parts		
710-60	Replacement Factors and Consumption Rates for Army Materiel		
711-16	Installation Stock Control and Supply Procedures		
711-25	Stockage of Supplies and Maintenance Authorized Stockage Lists		
711-40	Army Supply Status Reporting System; Installation Equipment Status Report		

750-312	Chemical Corps Technical Assistance Program	750-913	Calibration of Test Equipment for Ordnance Weapon and Guided Missile System
750-314	Maintenance Expenditure Limitations, Chemical Corps Equipment	750-930	Notice of Accomplishment of Ordnance Modification Work and Retrofit Order
750-370	Chemical Field Maintenance Shops and Missions	750-970	Ordnance Field Maintenance Shops and Missions
750-412	Technical Assistance in the Maintenance of QM Equipment	750-1500-4	Repair Limitations and Dispositions of Aircraft
750-428	Quartermaster Equipment Repair Limitations, Cost Criteria for Computing Repair Estimates and Disposition of Uneconomically Repairables	750-2300-6	Expenditure Limits for Repair of Commercial Design Vehicles
750-470	QM Field Maintenance Shops and Missions	750-2300-7	Expenditure Limits for Repair of Military Type Transport Vehicles
750-510	Application of MWO	750-2300-8	Depot Maintenance Standards for Ordnance Tactical Wheeled Vehicles
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750-520	Modernization Program, Repair or Overhaul Criteria—Corps of Engineer Equipment	754-10	Conservation of Materials
750-530	Corps of Engineer Equipment at NIKE-AJAX and NIKE-HERCULES Installations	755-Series	On Disposal
750-570	Engineer Field Maintenance Shop and Missions	755-6	Reporting of Installation and Technical Service Excess Personal Property
750-571	Uniform Procedures for Operation of Engineer Field Maintenance Shops, CONUS	780-10	Organization and Command Relationship
750-612	Maintenance Expenditure Limits, Signal Corps Equipment	780-11	Depot Missions—General
750-614	Signal Technical Assistance Program	780-15-1	Missions—Quartermaster Corps
750-615	Field Calibration of Signal Corps Test Equipment	780-63	Depot Operations—Program and Schedules
750-670	Signal Field Maintenance Shops and Missions	780-66	Major Overhaul and Maintenance of Materiel—Program 2300 (RCS CSGLD-946) Depot Overhaul Program for Selected Line Items (RCS CSGLD-947)
750-707	Transportation Corps Technical Assistance Program	780-370	Depot Missions—Chemical Corps
750-712	Modification of Army Aircraft and Transportation Air Items	780-570	Depot Missions—Corps of Engineers
750-713	Depot Maintenance of Army Aircraft	780-670	Depot Missions—Signal Corps
750-770	TC Field Maintenance Shops and Missions	780-770	Depot Missions—Transportation Corps
750-807	Technical Assistance in Maintenance of Medical Equipment	780-870	Depot Missions—Army Medical Service
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750-912	Ordnance Corps Technical Assistance Program	795-17	General Procedures for Furnishing Military Assistance to Foreign Governments on Grant Aid Basis
		795-21	General Procedures for Furnishing Supplies and Services for Oversea Civilian Aid Programs

795-204	General Procedures for Furnishing Military Assistance to Foreign Governments on a Reimbursable Basis	1257	Financial Inventory Accounting, Statement of Inventory Transactions
4. Department of the Army Circulars		1508	Major Overhaul and Maintenance of Materiel Program
Cir 750-22	Performance and Allocation of Maintenance Functions, Rebuild, Overhaul and Repair	1508-1	Depot Overhaul Program for Selected Line Items
5. Department of the Army Pamphlets		1535	Depot Operations, Program Performance
310-1	Military Publications, Index of Administrative Publications (includes—Army Regulations, Special Regulations, Circulars, Pamphlets, Commercial Traffic Bulletins, Military Traffic Management Bulletins, Joint Chiefs of Staff Publications, General Orders and Bulletins).	1535-1	Depot Operations, Program and Schedules
310-2	Military Publications, Index of Blank Forms.	1546	Request for Issue or Turn-In
310-3	Military Publications, Index of Training Publications (includes—Field Manuals, Reserve Officers Training Corps Manuals, Training Circulars, Army Training Programs, Army Subject Schedules, Army Training Tests, War Department and Department of the Army Posters, and Firing Tables and Trajectory Charts).	1794	Supply Control Study, Minor Secondary Items and Repair Parts
310-4	Index of Technical Manuals, Technical Bulletins, Supply Bulletins, Lubrication Orders and Modification Work Orders.	1886	Financial Inventory Accounting, Supply Management Report, (CONUS only)
6. Department of Defense Forms		1887	Financial Inventory Accounting, Supply Management Report, (Installation Inventories)
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811	Work Request and Job Order	14-115	Purchase Request and Commitment
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		Section III	Procurement by Negotiation
		Section XV	Contract Cost Principles and Procedures
		Section XVI	Procurement Forms—Part I Forms for Advertised Supply Contracts and Part II—Forms for Negotiated Procurement

9. Army Procurement Procedure

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Section III Procurement by Negotiation

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NG: State AG (3) Corps Arty; Div Arty; Bde (2): BG; Bn; TOE 17-22 (1).

USAR: Same as Active Army except allowance is one copy to each unit except Centers (none).

For explanation of abbreviations used, see AR 320-50.

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BAY AND PRODUCTION LINE MAINTENANCE PROCESS FLOW

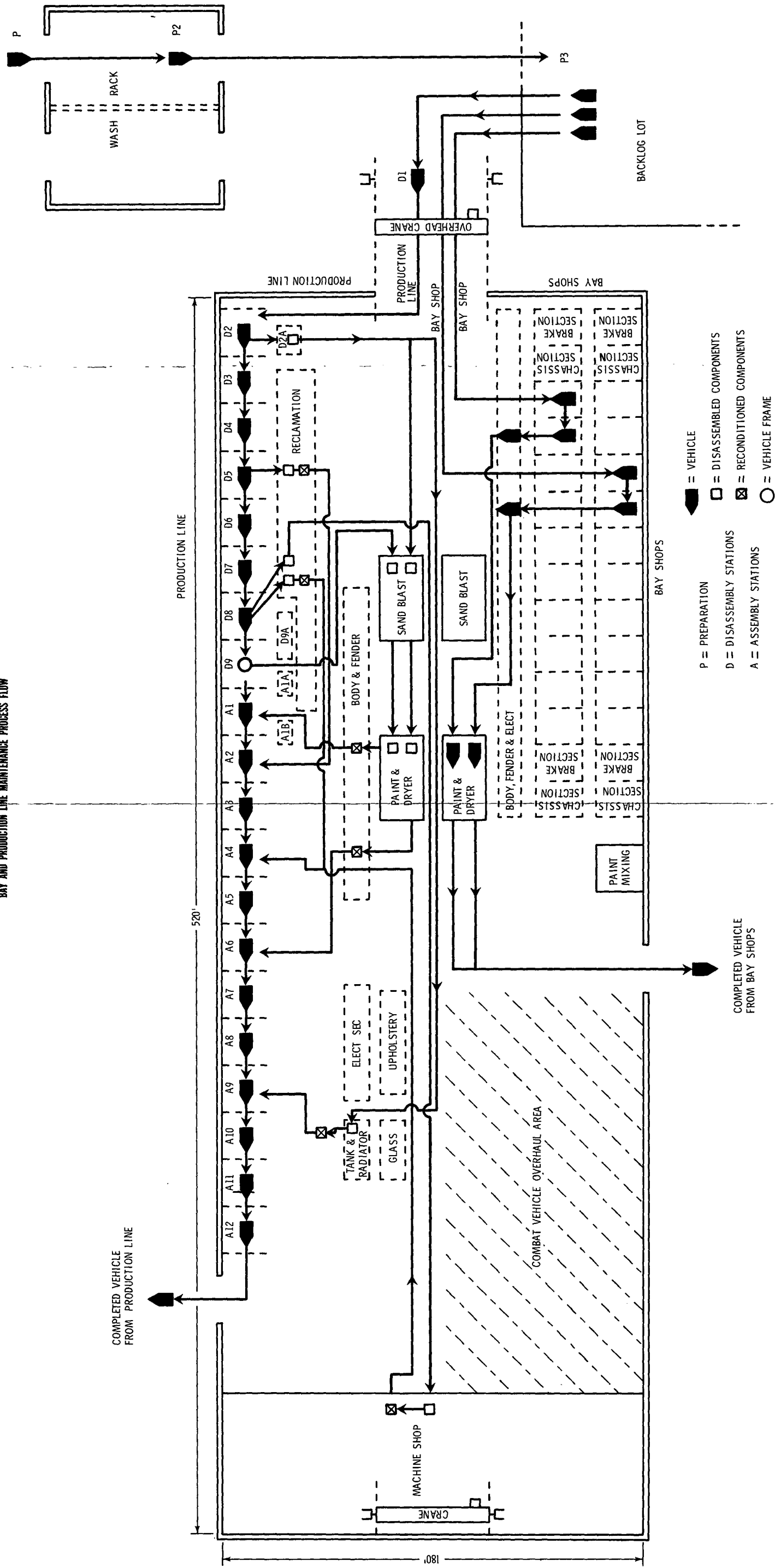


Figure 10. Bay and production line major overhaul process flow.